

Rock Art Conservation Management for Site Stewards

2019 Annual Meeting Society for California Archaeology

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Standing Rock Sioux Tribe



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Warning

The following presentation contains graphic images of rock art deterioration and desecration that may be disturbing to rock art site stewards. Viewer discretion is advised.

“The first rock art was put there by the people that came before during the time of the stories. The rock art was created to prepare the world for those who were to come.”

-Ernest Siva Morongo Band

I. Conservation Management Plans

II. Transformational Processes

III. Conservation Management Study

IV. Data Collection and Monitoring

V. Intervention Methods



Conservation Management

[Conservation is]
all the processes of looking
after a place so as to retain its
cultural significance.

-The Burra Charter



Oasis of Mara, Twentynine Palms, California

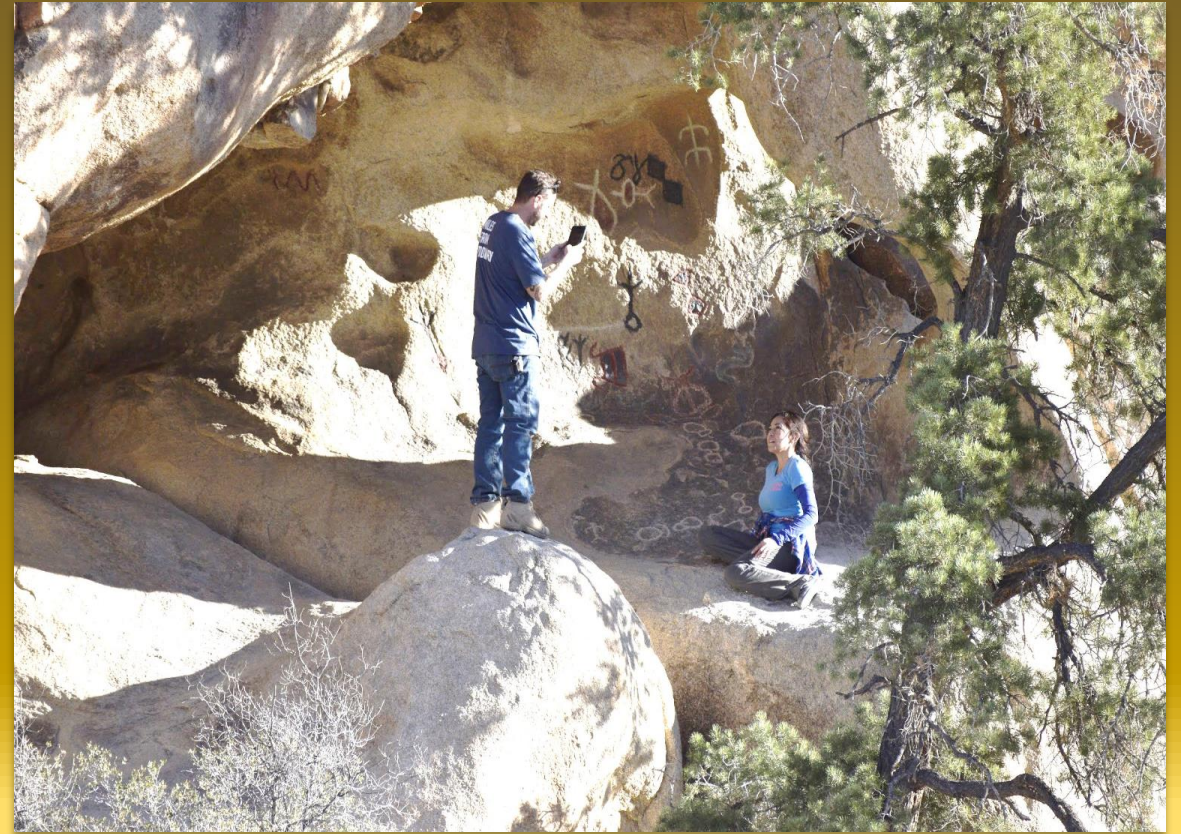
A conservation management plan comprises a proscribed set of behaviors aimed at slowing the rate of deterioration resulting from natural and anthropogenic processes.

Options for Site Conservation

- Maintenance – maintaining a tidy site (e.g. removing litter, brushing away dust, removal of dead plants and animals, etc.)
- Preservation – involves hands-on treatment not directly impacting a panel (e.g. diverting water with channels or artificial barriers, etc.)
- Restoration – involves treatments to panel (e.g. removal of lichen and graffiti)
- Reconstruction – repainting or regrooving or figures to restore to original appearance

Why Conservation Management?

A site can ultimately be managed in a systematic, planned way or it will be inherently managed by visitors that may be unaware of the conservation needs of a site.



Disney Glyphs, Joshua Tree National Park

NPS Organic Act

54 U.S.C. Code § 100101 – Promotion and regulation

(a) **In General.** – The Secretary, acting through the Director of the National Park Service, shall promote and regulate the use of the National Park System by means and measures that conform to the fundamental purpose of the System units, which purpose is to conserve the scenery, natural and historic objects, and wildlife in the System units **and** to provide for the enjoyment of the scenery, natural and cultural objects, and the wildlife in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

Criteria for Intensive Management

- 1. Accessibility of site and number of visitors that frequent site
- 2. Condition of the rock art
- 3. Significance of site
- 4. Uniqueness of site
- 5. Cost of managing a site

Approaches

- **Substantive Approach** – identification of natural and cultural processes that affect preservation or deterioration of a site
- **Formalist Approach** – implementation of conservation-oriented procedures to reduce or minimize deterioration and actively preserve a site

Site Management

- Site management more successful if it follows pre-existing visitor patterns
- Restricting access to publicly-known sites is difficult and ineffective
- Some sites thought of as **sacrificial** sites
- Well-managed sites can have visitation while maintaining conservation needs

Reasons People Visit Sites

- Admire aesthetic quality of art
- Curiosity
- Thrill of seeing new places
- Love of outdoors
- Love of history/archaeology



Curly Tail Panther, Texas

Effects of Increased Visitation

- Large groups of people crowding into shelter can result in inadvertent contact with panels
- People tend to touch panels when in small groups
- Larger groups self-regulate
- Large groups more difficult to monitor
- Foot traffic stirs up particulates
- Trails can change drainage patterns
- Change Microclimate



Rock Art Site Management Strategies

- 1. The identification of the processes contributing to the deterioration
- 2. The development of a ranking system that prioritizes sites based on their level of risk
- 3. Establishment of specific monitoring protocols for sites based on the level of risk

Adapted from Geisen et al (2014)

Purpose of a Management Plan

- Outline significance of a site;
- Determine why conservation is necessary at a site;
- Identify the conditions affecting the site;
- Propose ways to conserve the site

Conservation Management Plan

- Document that includes a list of protocols outlining the current threats to a site and recommendations for maintaining a site in such a way so as to slow the effects of natural and anthropogenic agents leading to the deterioration of the site
- Provides a description of any previously applied treatments to the site and recommended future treatments
- Provides a justification for treatments and establishes a way of monitoring the effects of the treatments
- Provides a baseline from which observations during future monitoring can be compared
- Establishes a method of monitoring any changes to a site that may include periodic site visits

Planning

- Conservation should be relatively non-intrusive
- Adding to or removing anything from a site could accelerate, rather than decelerate, the deterioration of a site
- Poorly planned intervention could be more destructive than no intervention

4 Concepts in Conservation Activity

- Minimal intervention – a site should be altered as little as possible
- Repeatability/Reversibility – techniques that can be reversed back to original state before action was taken
- Compatibility – use of material that is inert and will not react with the surface physically and chemically. Should also be aesthetically compatible.
- Distinguishability – any changes that are made should be distinguishable from conditions present prior to treatment

Steps in Conservation Management

- 1. Consultation with all interested parties
- 2. Recording
- 3. Assessment
- 4. Review of alternative treatment options
- 5. Testing of preferred treatment options
- 6. Intervention

Things to Keep in Mind

- Conservation is not preservation
- Every site has multiple stake-holders with disparate interests
- Different sites require different management styles
- Every site is unique



Transformational Processes

Transformational Processes

“These processes include all conditions and events that affect those material remains from the time of deposition [creation] to the time the archaeologist recognizes and acquires them as data”

Ashmore and Sharer (1996)

Weathering Front

The contour of the
deepest visually
discernable alteration
of the general
lithosphere



CA-RIV-933, Joshua Tree National Park, California

Natural vs. Cultural Transformational Processes

- Natural Transformational Process (N-Transforms)
- Cultural Transformational Processes (C-Transforms)

N-Transforms

- Physical Agents
- Chemical Agents
- Biological Agents

Physical Agents

Type of Support

- Parietal
- Frieze
- Talus
- Glacial Erratic
- Tor
- Tufa
- Earth Figure



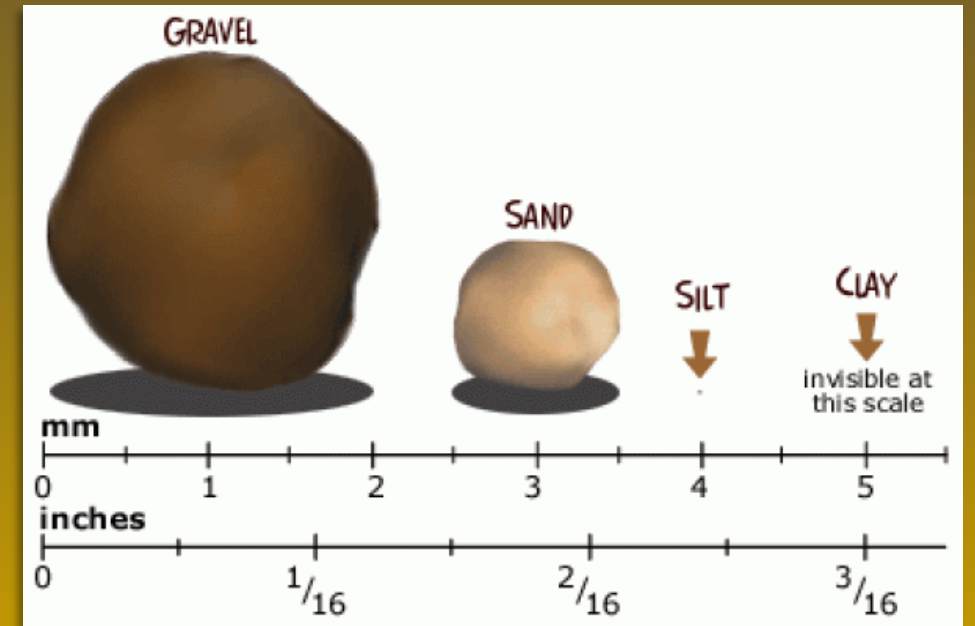
Fissures

- Frost Wedging
- Fissuresols
- Leaf Litter
- Thermal Shock
- Seismic Activity



Properties of Pigment

- Mineral-based pigments last longer than organically based pigments
- Type of binder used to make paint may affect preservation
- Particle size of the pigment affects preservation
- Hematite has a smaller particle size than goethite and limonite and adheres to support more securely



Fluvial Processes

- Flash floods
- Vertical flows
- Spring vents
- Seeps
- Direct Precipitation



Running Deer Shelter, Texas

Flash Floods

- **Erosion** – may remove all but better bonded paint and subsurface deposits
- **Sedimentation** - deposition of fine sediment in fissures and cavities
- **Abrasion** - resulting from debris carried by fast-flowing water



Eagle Nest Canyon, Langtry, Texas

Vertical Water Flows

- **Mineral staining** – e.g. iron staining
- **Erosion** – may leave a sharp vertical cut on a figure
- **Scouring/rillen** – creates furrows in rock support
- **Sheet wash** -may remove all but red paint



Seeps

- Associated with spring vents or solution cavities
- Discharge water from rock face
- Can result in erosion of figures or mineral accretion
- Figures in vicinity of spring vents probably intentionally incorporated into them



Raymonds Shelter, Langtry, Texas

Weathering Rinds

- Will have a rough orange peel-like surface
- Often exhibit a distinct color difference
- Formed by the accumulation of elements (e.g. Iron), depletion of cations (e.g. calcium or sodium), or oxidation of iron



Hawley Lake, Tahoe National Forest

Mineral Accretion

- Silcrete (SiO_2)
- Calcium Carbonate (CaCO_3)



Red Lady, Joshua Tree National Park

Calcium Carbonate

- Ranges from being nearly transparent to a thick milky white layer over rock art figures
- Referred to as **calcification**
- Occurs when water containing calcium carbonate loses CO_2
- Results from same process that produces tufa, stalactites, and stalagmites



White Shaman, Comstock, Texas

Salt Erosion

- May appear as aviolization, tafone, pedestal rocks, scalloping, or rock debris
- Can lead to degradation of rock surface or lead to exfoliation
- Affects rock in 3 ways: salt crystallization, salt hydration, and salt expansion



Tomo Khani, Tehachapi, California

Salt Erosion

- Salt within the rock support is dissolved and transported by ground water
- The solution penetrates the pores of the stone
- Salt precipitates within pores or on rock surface through evaporation
- Salt crystals then expand and crystalize

Salt Erosion

- Efflorescence – manifests on rock surface (can be viewed macroscopically)
- Subflorescence – manifests in interstices of rock support
- Efflorescence less destructive than subflorescence



Efflorescence vs. Subflorescence

- Type of salt (e.g. sodium chloride effloresces; mirabolite and thenardite subfloresce)
- Environment also a factor (e.g. humidity, rate of air exchange, etc.)
- Surface tension of the solution (e.g. sodium sulphate with higher surface tension prone to rapid evaporation)

Other factors of salt erosion

- Salt solution within rock reduces interfacial tension
- Thermal expansion of salt (e.g. sodium chloride expands five times)
- Can lead to the dissolution of calcite

Abrasion



Dust Storm, Twentynine Palms, California

Abrasion

- Fluvial – debris carried by fast moving water
- Sediment affixed to panel
- Aeolian Abrasion – abrasion resulting from wind-suspended particles
- Panel Deflation – wind scouring
- Gravity – particulate matter moving across panel via gravity



CA-RIV-930 Joshua Tree National Park

Rock Support Degradation

- Crumbly Disintegration
- Granular Disintegration
- Exfoliation
- Lacuna
- Clastic Waning



Halden Shale, Chisos Mountains, Big Bend National Park

Heat and Light

- Diurnal temperature changes can physically alter paint
- Dehydration and increased temperature (i.e. as low as 104° F) can convert Goethite (yellowish-brown mineral) to Hematite (red mineral) through following reaction:
- $2\infty\text{FeOOH} = \infty\text{Fe}_2\text{O}_3 + \text{H}_2\text{O}$



Chemical Agents

Water

- Medium through which chemical reactions occur
- Most water slightly acidic containing atmospheric gases (e.g. carbon dioxide, nitrous, nitric oxide, and sulfur dioxide)
- Can dissolve rock particularly limestone, marble, and sandstone
- Rainwater can leach organic acids from sediment above shelters



Case Hardening/Core Softening

- Sometimes called induration
- Outer surface of rock becomes more weather resistant than interior
- Can result from 2 processes:
 - Softening of core
 - Hardening of surface
- May result from evaporative stress and precipitation
- May result from external agents penetrating rock



Case Hardening – 3 Step Process

- 1. Silica, aluminum, and iron compounds precipitate within joint facies
- 2. Joint facies are exposed through deflation of the land surface
- 3. Cavities, known as tafoni, are created as the rock below the case-hardened surface erodes



Rock Coating Accretion

- Silica Glaze
- Iron Film
- Patination



Coyote Hole, Joshua Tree, California

Silica Glaze

- Consist of silica, aluminum, and iron
- Precipitate from alumina-silica compounds derived from weathering of clay minerals
- Exhibit a white to orange luster



Iron Films

- Consist of iron oxides and oxyhydroxides
- Can result from iron oxidizing bacteria or redistributed by acids
- Can lead to accelerated panel erosion by fracturing quartz grains or trapping water in internal pores



Patination

- Also called rock varnish or desert varnish
- Form through a variety of processes including: bleaching, leaching, limonite staining, mineral accretion, chemical alteration, and abrasion or polish by sediment grains
- Form endogenously as part of physical and chemical properties of rock
- Can form exogenously resulting from external matter affixed to rock surface



Corn Springs, California

Patination

- Consists of 60% clay minerals; 20-30% oxides of manganese or iron; and trace amounts of copper and zinc oxides
- Manganese is concentrated on rock surface by bacteria
- Bacteria secrete an enzyme that cements clay particles to rock surface
- Varnish first forms at nucleation centers of bacteria colonies and then spreads across rock surface

Patination Color

- The amount of manganese determines the color
- Manganese to iron ratio determined by pH level
- Alkaline pH levels inhibit manganese-fixing bacteria resulting in high iron concentration
- Clay particles not securely fixed to surfaces high in iron resulting in orange varnish



Dragon Wash, Joshua
Tree N.P.



China Lake,
Ridgecrest, California

Oxalate Crusts

- Whewellite ($\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$)
- Weddellite ($\text{CaC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$)



Ryan Ranch, Joshua Tree N.P.

Oxalate Crusts

- Formation is poorly understood
- Various agents have been suggested including: lichen, bacteria, reactions to organic compounds, animal urine, artificial application to protect imagery, lost tribes of Israel
- Some authors suggest they are related to xeric lichen species (e.g. *A. calcerea*)



Oxalate Crusts

- Xeric lichen species obtain moisture from water vapor and die when moisture levels exceed threshold
- Russ et al (1999) suggest that formation the whewellite in the Lower Pecos indicates period xeric environments throughout prehistory
- Mesic-xeric fluctuations led to proliferation and recession of lichen activity
- Through radio-metric dates that identified 5 periods of lichen expansion resulting in whewellite deposits
- They suggests that no significant oxalate crusts have formed since 680 BP

**WE WILL GO
DOWN THE
LICHEN RABBIT
HOLE AFTER THIS**

Break



Biological Agents

Lithobionts

- Cyanobacteria
- Mold
- Fungus
- Lichen
- Moss
- Algae



Rocky Hill, Exeter, California

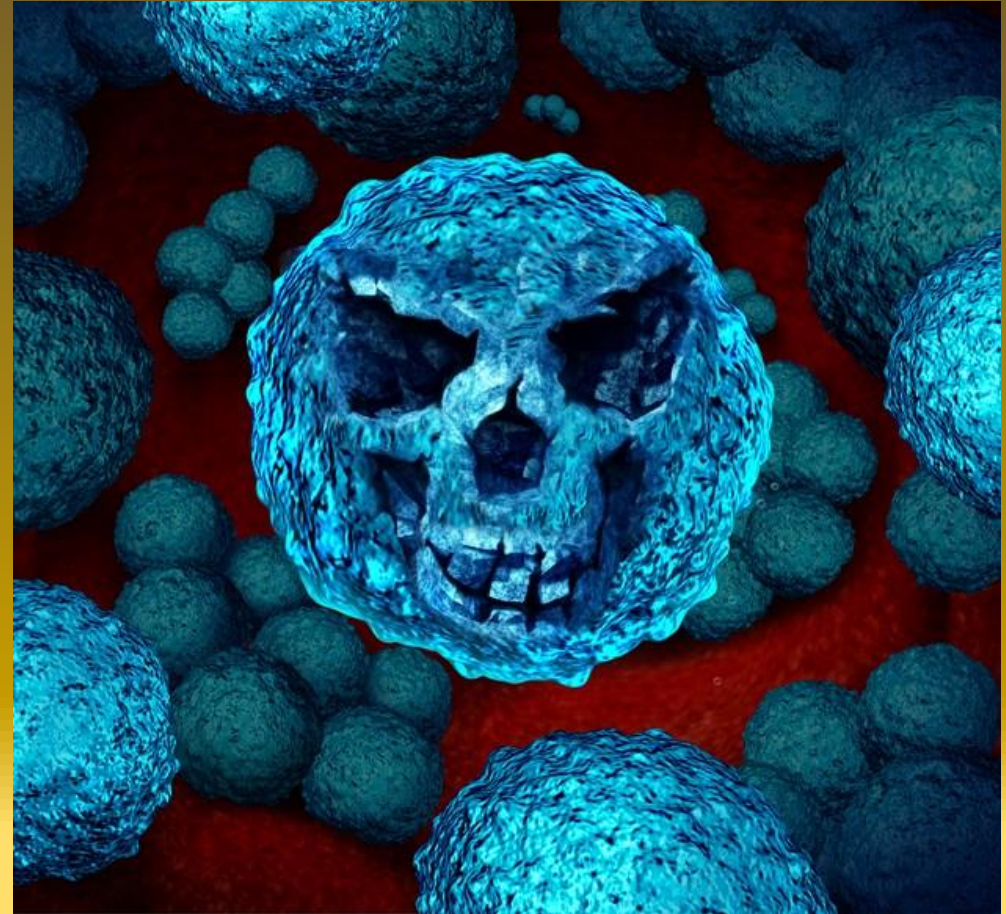
Microbes

- Can dissolve rock as source of energy, as terminal electron acceptor in cellular respiration, as trace element requirements, and to enhance competitiveness in community
- Other microbes lead to mineral formation through: oxidation or reduction through metabolism, detoxification of poisonous inorganic species, during uptake of dissolved inorganic species, and enhancing competitiveness in community



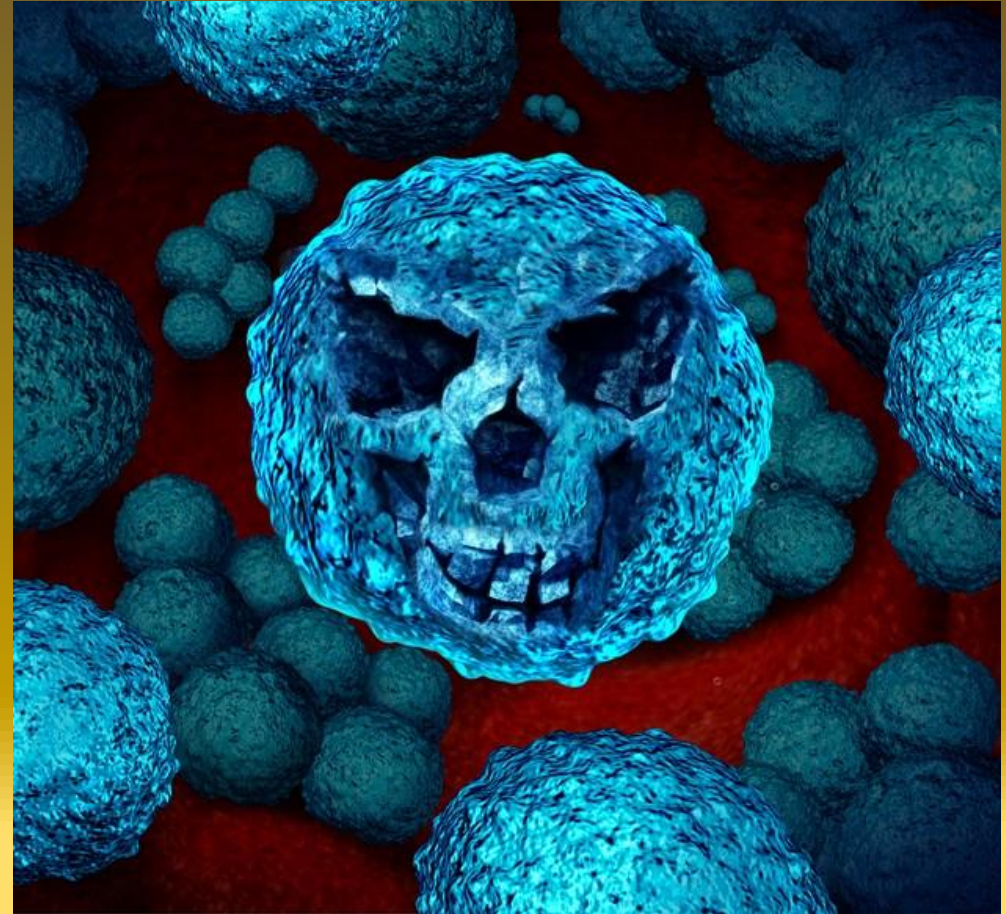
Autotrophic Bacteria

- Obtain carbon from CO_2
- Obtain energy from light or chemical redox reaction
- Oxidize sulphur and nitrogen compounds
- Produce ammonia, nitrous, sulfurous, sulfuric, and nitric acids



Heterotrophic Bacteria

- Obtain carbon from organic compounds on stone
- Produce organic acids that are weaker than those produce by autotrophic bacteria

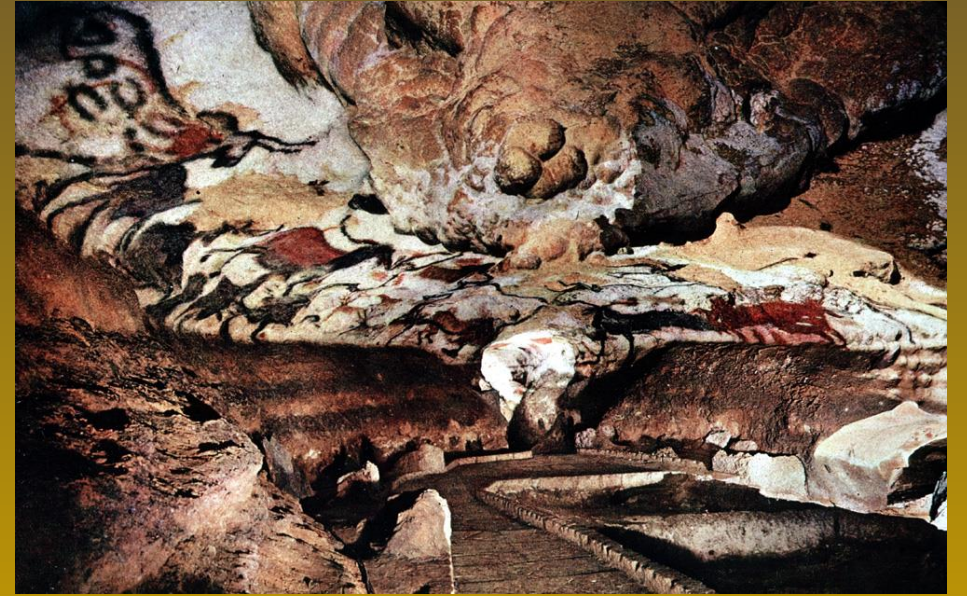


Effects of Bacteria

- Produce slime of extracellular polymeric substances that make biofilm (contains polysaccharides, water, and proteins)
- Biofilms can dissolve limestone and result in pitting
- Some strains of cyanobacteria disrupt molecular structure of rock by precipitating crystals on their polysaccharide sheath

Fungi

- Certain varieties of thyllophyta produce no chlorophyll and live in areas of little to no light
- Survive on small amounts of moisture and airborne organic material
- Produce oxalic and citric acids which can result in hydrolysis of silicate
- Less prominent on rock containing calcium where bacteria proliferate



Lascaux, France

Moss

- Effects of moss on rock support unknown
- Some authors suggest it can lead to the crumbling of the rock support
- Other authors suggest the penetration of the rhyzoids in insignificant to cause deterioration
- Moss proliferates where the moisture and light levels of ideal



Allegheny N.F., Pennsylvania

I'm really Lichen it

- Lichen consists of a fungus and photosynthetic organism (e.g. algae, cyanobacteria) that grow together symbiotically
- Fungus forms the thallus or stroma
- Independently the two organisms require more mesic conditions
- Have greater tolerances as lichen



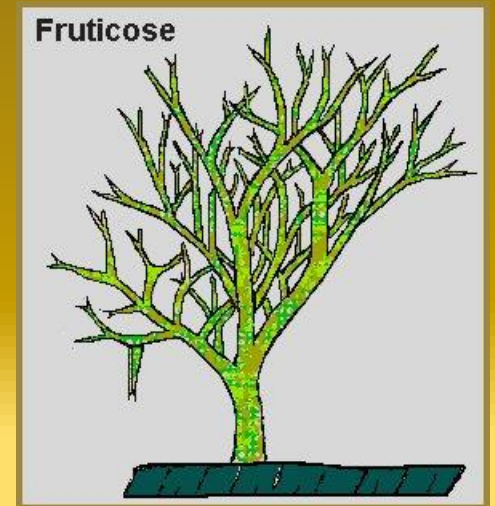
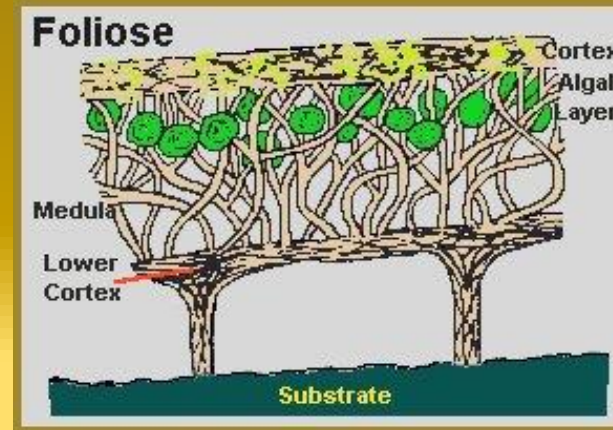
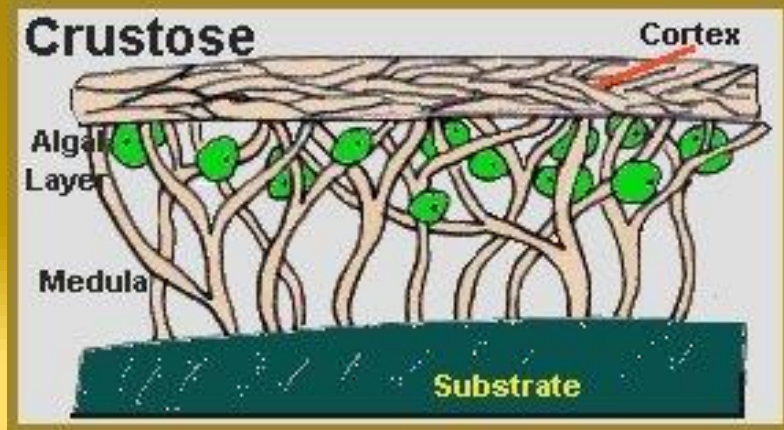
Lichen on Rock Substrates

- Lichen species that grow on rock surfaces are known as **saxicolous** species
- Some species grow on rock surface while others will be embedded within support



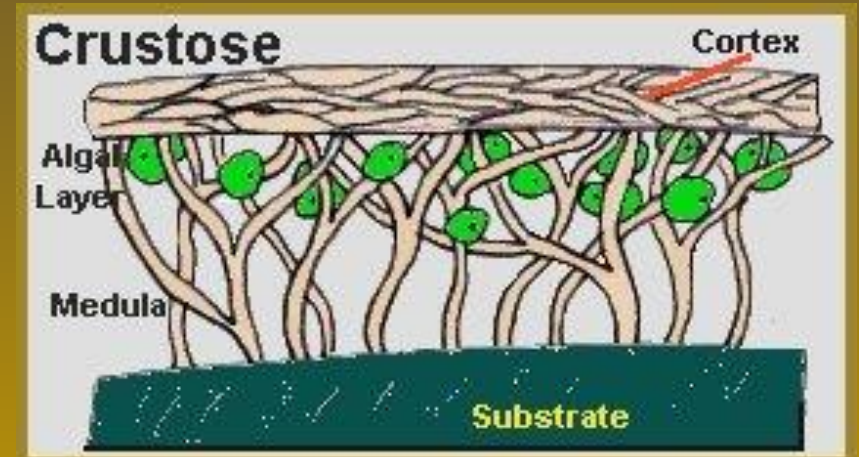
Types of Saxicolous Species

- Classified by thallus and mode of attachment to rock support: **crustose**, **foliose**, and **fruticose**



Crustose

- Can be classified as **epilithic** (attaches to rock surface) or **endolith** (penetrates the interior of the rock)
- Three types of endolith lichen:
 - Cryptoendolith – grow in natural cavities
 - Chasmoendolith – grow in fissures and cracks
 - Euendolith – bore into rock surface



Effects of Lichen on Rock Art

- Effects of lichen poorly understood
- Some authors suggest it adversely affects rock art, others suggest it has a negligible effect
- Bakkavig (2004) suggests that the weathering attributed to lichen may simply be that it prefers weathered surfaces or the thallus simply collects weather rock material
- Bakkavig (2004) suggest that lichen helps protect rock art from panel deflation and/or delay the freezing of a panel



Lichen – Wet/Dry Cycles

- Hypha penetrate inter-granular voids and mineral cleavage planes
- Wet/dry cycles can cause thallus to expand and contract
- Medulla is hygroscopic and can expand 300% its dry weight
- When thallus is wet medulla expands inducing mechanical stress
- When thallus dries it shrinks pulling rock particles with it

Lichen – Freeze/Thaw

- Freeze/thaw takes place in microclimate created by lichen
- Moisture trapped in thallus expands when freezes
- Due to hyphal penetration this can induce ice-wedging relatively deep in rock surface



Lichen – Solubilization of Minerals

- Lichens solubilize minerals through release of respiratory CO_2 , excretion of oxalic acid, and production of biochemical compounds with complexing agents
- During respiration CO_2 is dissolved in water retained in thallus
- Creates carbonic acid
- Lowers the pH of the thallus and local environment
- Results in dissolution of iron and aluminum compounds in paint

Lichen – Oxalic Acid

- Oxalic acid secreted by mycobionts of many lichen species
- Oxalic acid contains hydrogen ions that react with minerals to form cation-organic complexes with OH^{-1} or COOH^{-1} groups in the ortho position
- Leads to shift in electron density leading to increased charge in cation-oxygen bonds making them more susceptible to hydrolysis
- Lichen can also create citric acid or gluconic acid that can also lead to weathering

Lichen Weathering on Different Rock Supports

- **Sandstone** – dissolve cementing agent between sandstone grains
- **Basalt** – mobilization of iron and magnesium and release calcium and aluminum that results in precipitation of iron oxides and calcium oxalates
- **Granite** – micaceous minerals (e.g. biotite) exhibit morphological and chemical alteration and reduces the size of biotite flakes
- **Calcareous** – oxalic acid dissolves calcite in limestone and dolomite and leads to precipitation of calcium oxalate

Lichen - Calcium Oxalate

- Metal oxalates created when oxalic acid excreted lichen
- Reacts with minerals – **calcium oxalate** most common form
- Calcium oxalate precipitates as Ca^{2+}
- Can form on substrates with little calcium (e.g. granite)
- Calcium oxalate accumulates beneath thallus as hydrated salts
- Most common is **whewellite** (monohydrate) and lesser extent **weddellite** (dihydrate)
- Whewellite forms **platey** structures – weddellite forms **bipyramidal** structures

Lichen – Clay Minerals

- Lichen can lead to formation of clay minerals including:
kaolinite, halloysite, vermiculite, goethite, illite, allophane, and
imogolite
- Type of clay depends on substrate and lichen species

Lichen – Aeolian Dust

- Lichen thalli can collect aeolian dust
- Particulates trapped in thalli include hygroscopically-susceptible argillaceous particles introduced into fissures and cavities
- Collection of particulates may promote environments for other weathering agents (e.g. plants, microbes, etc.)
- Aeolian particles may contribute to formation of biogenic varnished stains and crusts

Flora

- Creepers and vines may grow in and around seeps
- Tall grasses may grow near springs and wetlands
- Trees and shrubs may grow in sediment within rockshelter or adjacent to friezes
- Shrubs may grow out of cavities



Benefits of Flora

- Stabilize sediment
- Reduce effects of aeolian dust
- Prevent erosion/deflation of shelter floor deposits
- Obscure the site from visitors



Hibiscus Rockshelter, Texas

Flora

- Abrasion
- Root expansion
- Wildfire
- Acidic secretion
- Influences on micro-environment
- Deposition of detritus



Terrestrial Fauna

- Abrasion
- Salt Licks
- Ground Disturbance
- Stirring up particulate matter



CA-RIV-931, Joshua Tree N.P.

Avian Fauna

- Nests
- Droppings



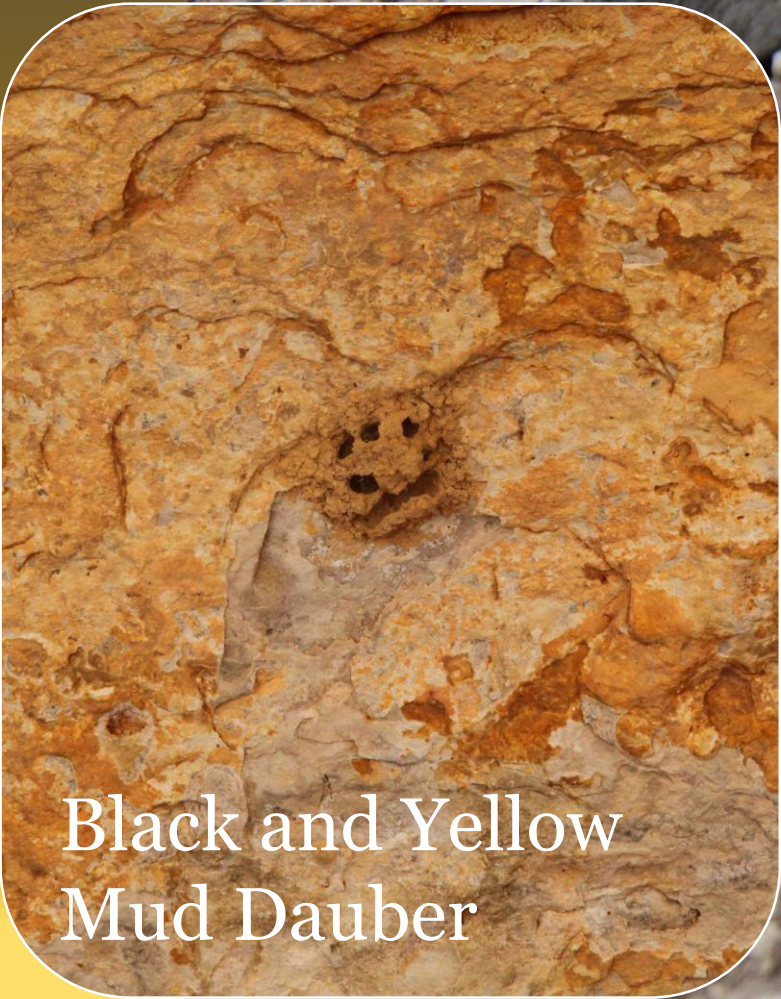
China Lake, Ridgecrest, California

Insects

- Mud Daubers
- Ants
- Bee nests
- Spider webs



Mud Daubers



Black and Yellow
Mud Dauber

A close-up photograph of a mud dauber nest. The nest is constructed from a mixture of black and yellow mud, showing a textured, layered appearance. Several small, dark, circular openings are visible, arranged in a somewhat circular pattern.



Blue Mud Dauber

A close-up photograph of a mud dauber nest. The nest is constructed from a light-colored, yellowish mud. A prominent feature is a large, irregular, white, crystalline or mineral deposit in the center of the nest. The surface is textured and shows some signs of weathering.



Pipe Organ Mud
Dauber

A close-up photograph of a mud dauber nest. The nest is constructed from a light-colored, yellowish mud. It features a series of vertical, parallel tubes or pipes, each with a small, dark, circular opening at the top. The overall structure resembles a pipe organ.

Bee Nests



Painted Shelter, Texas

C-Transforms

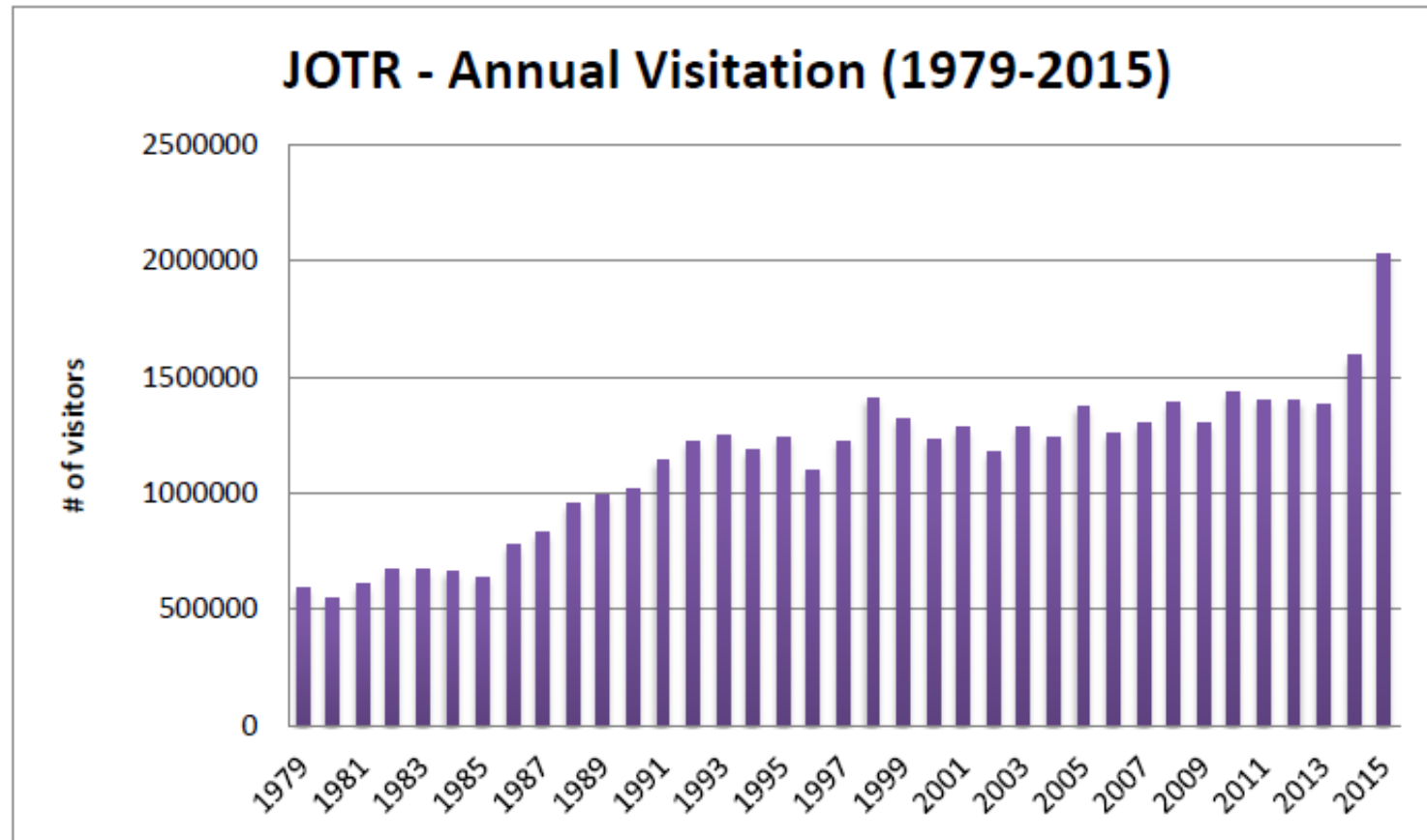
- Direct Anthropogenic Agents
- Indirect Anthropogenic Agents

Direct Anthropogenic Agents

Visitation



Increased Visitation



Social Media & The Web


The screenshot shows a web browser window with the URL `deathvalleyjim.com`. The page features a navigation bar with a "View all" button. The main content area is titled "Latest in Native American" and displays a photograph of petroglyphs on a rock in a desert landscape, with a circular logo in the top right corner. Below the image is the text "DRAGON WASH PETROGLYPHS (JOSHUA TREE NATIONAL PARK)". To the right, there are two promotional sections: "DEATH VALLEY HOT SAUCE" featuring two bottles and the text "AVAILABLE NOW!", and "SECRET PLACES IN THE MOJAVE DESERT VOL. 7" featuring a book cover and the text "AVAILABLE NOW!". The Windows taskbar at the bottom shows the date and time as 5:57 PM on 12/11/2016.

Sample NPS Power Poi | Rock Art Conservation | Slides: Rock Art Presen | Data Tracking - Google | (97) Death Valley Jim - | Death Valley Jim - | DZRTGRLS | how to save a print scrn

deathvalleyjim.com


View all

Latest in Native American



DRAGON WASH PETROGLYPHS (JOSHUA TREE NATIONAL PARK)

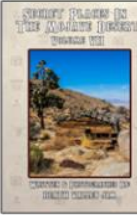
DEATH VALLEY HOT SAUCE



DEATH VALLEY
HOT SAUCE
AVAILABLE NOW!

SECRET PLACES IN THE MOJAVE DESERT
VOL. 7

AVAILABLE NOW!



Volume 7 in the Secret Places in the Mojave Desert series. Featuring all new locations around Barstow, Saline Valley, San Bernardino Mountains, Southern Nevada, Valley of Fire, and Twentynine Palms.

Ask me anything

5:57 PM 12/11/2016

OHV Traffic



Litter

- Perceived Neglect
- Arlo Guthrie Trash Magnet Effect



Rock Climbing and Bouldering



Campfires



Vandalism

- Opportunistic
- Pre-meditated



Opportunistic Vandalism

- Vandalism executed using something in the immediate environment or something that people typically carry on their person:
 - Sharpie
 - Charcoal
 - Lipstick
 - Chalk
 - Pocket knife
 - Pebble

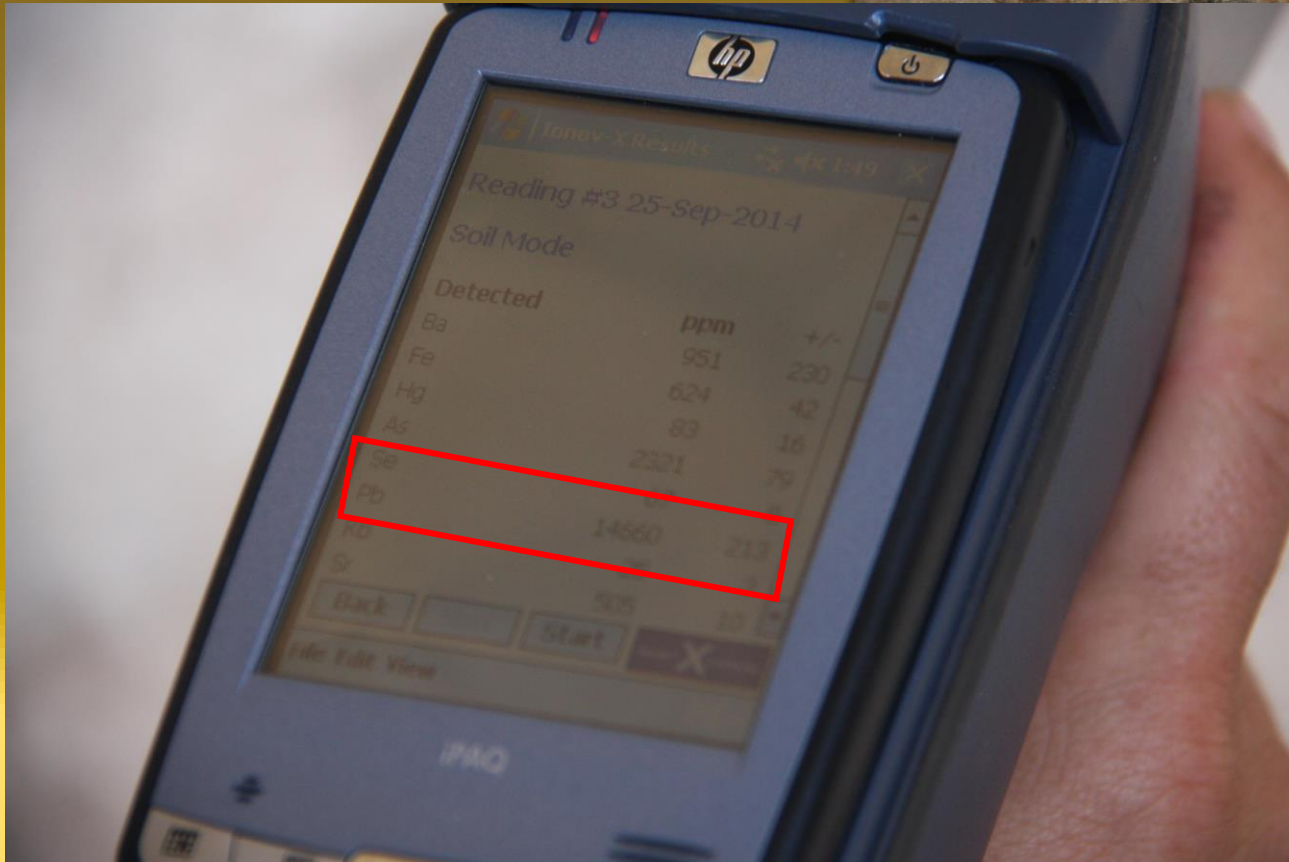


Pre-meditated Vandalism

- Vandalism executed using something not in the immediate environment and implies intention:
 - Spray paint
 - Tool marks
 - Caustic chemicals

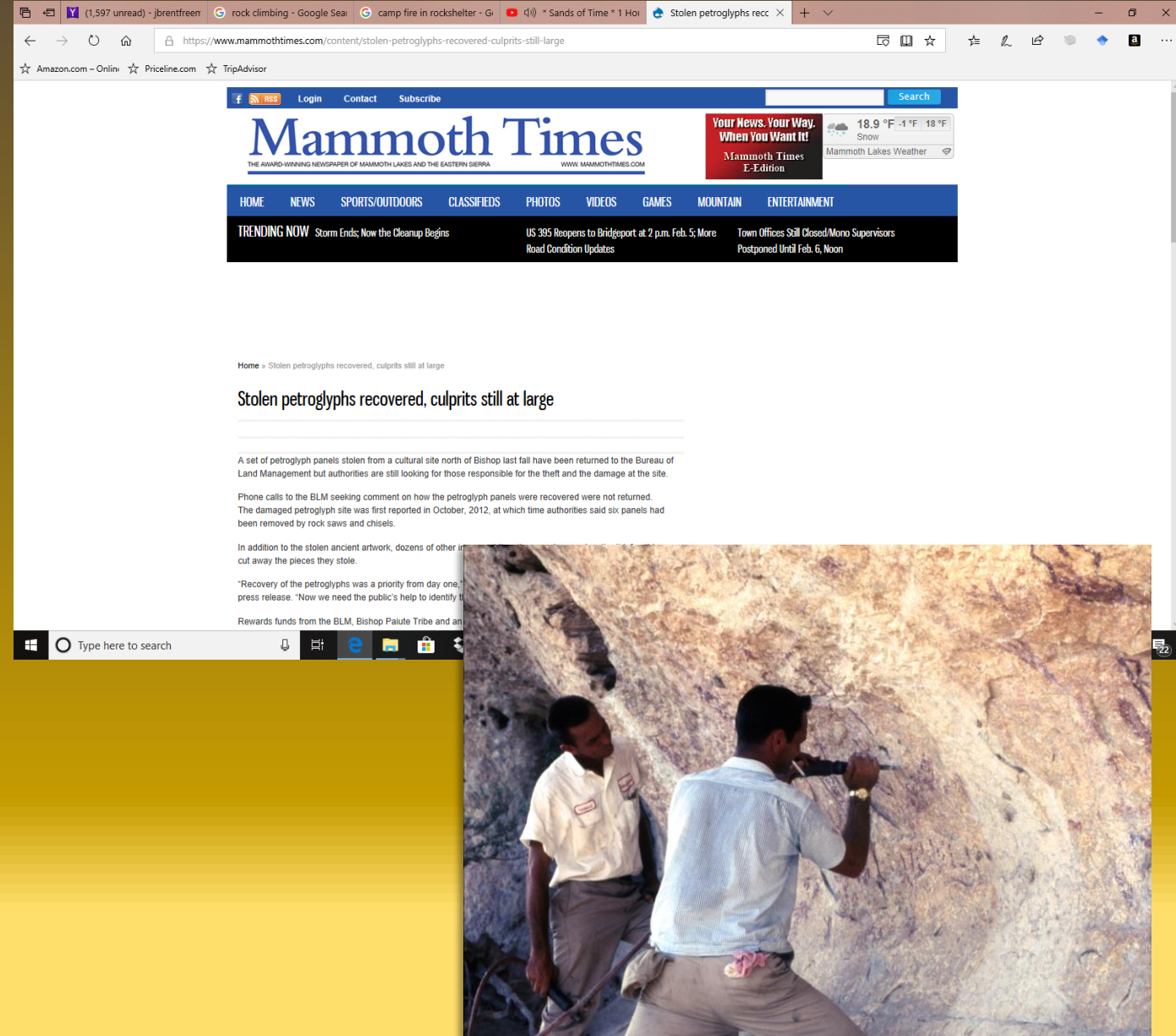


Discharging of Firearms



Theft

- Removal of petroglyphic boulders
- Removal of sections of panel
- Removal of artifacts from subsurface deposits



Theft

Form 10-71
(July 1973)

UNITED STATES DEPARTMENT OF THE INTERIOR
ANTIQUEITIES ACT PERMIT
NO. **76-NV-089**

To Conduct Work Upon Lands Owned or Controlled by the United States Under the Act For The Preservation of American Antiquities
(Approved June 8, 1906 (34 Stat. 225, 16 U.S.C. 432, 433) and the Regulations Thereunder)

1. PERMIT ISSUED TO: University of California/Berkeley; Berkeley, California DATE: August 5, 1976

2. NAME, ADDRESS AND OFFICIAL STATUS OF PERSON:

a. In general charge: [Redacted] [Redacted]
Director, Archaeological Research Facility
Senior Staff Member
University of California/Berkeley
(Address the same)
Berkeley, California 94720

b. In actual direct charge: [Redacted]
(Address same as above)

3. UNDER APPLICATION DATED: April 29, 1976

4. AUTHORIZES: Archeological Investigations (Excavations)

5. ON LANDS DESCRIBED AS FOLLOWS:
Department of the Interior lands administered by the Bureau of Land Management (Carson City District) in the State of Nevada: Grimes Point Petroglyph Site (NV-Ch-3) and Lyon 1 Petroglyph Site (NV-Ly-L); T18N, R30E, SE 1/4 of the SW 1/4 and SW 1/4 of the SE 1/4 of Section 20; NE 1/4 of the NW 1/4 of Section 29.

6. FOR PERIOD: August 5, 1976 through August 4, 1977 (one year)

7. MATERIALS COLLECTED UNDER THIS PERMIT WILL BE DEPOSITED FOR PERMANENT PRESERVATION IN THE
Robert Lowie Museum of Anthropology
University of California/Berkeley

OR IN OTHER ACCREDITED INSTITUTIONS UNDER SUITABLE LOAN AGREEMENTS.

8. SPECIAL CONDITIONS
This permit is subject to the provisions of the Act for the Preservation of American Antiquities approved June 8, 1906, and the interdepartmental regulations including 25 CFR 132, as to Indian lands, promulgated thereunder (copies attached), as well as the special conditions on the reverse of this form.

9. PRELIMINARY REPORT
Within approximately 6 weeks of the conclusion of field work, a preliminary report on work performed under this permit, illustrated with representative photographs and listing new and significant collected materials should be furnished the Secretary, Smithsonian Institution, and 5 copy(s) thereof should be forwarded to this Department.

DEPARTMENTAL CONSULTING ARCHEOLOGIST (Signature) [Redacted]



Destructive Documentation Methods

- Application of water
- Application of caustic chemicals (e.g. kerosene)
- Chalking
- Placing of plastic films on imagery to trace
- Rubbings
- Latex models
- Adhering IFRAO scale to panel to photograph



Destructive Documentation Methods

Case Study 1:
Lewis Canyon, Texas



Destructive Documentation Methods

Case Study 2:
Allegheny N.F.



Destructive Documentation Methods

- Case Study 2:
Allegheny N.F.



Destructive Documentation Methods

- Case Study 2:
Allegheny N.F.



Destructive Restoration

- Retouching figures
- Enhancing Figures
- Gluing exfoliated spalls
- Infilling crevices with mortar
- Applying chemicals to imagery (e.g. Thomson's waterseal, anti-freeze, biocides, polymeric consolidants, etc.)



Anza Borrego State Park, California

Indirect Anthropogenic Agents

Indirect Anthropogenic Agents

Looting



Indirect Anthropogenic Agents

Livestock

- Rock shelters used as livestock corals
- Livestock stir particulate matter
- Disturb subsurface deposits
- Rub against panels
- Salt licks



Indirect Anthropogenic Agents

Climate Change



Las Labradas, Mexico

Indirect Anthropogenic Agents

Wildfire



Indirect Anthropogenic Agents

Alteration of Natural Drainage
Patterns



Indirect Anthropogenic Agents

Landscape modification/terraforming



Indirect Anthropogenic Agents

Pollution

- Term acid rain first introduced in 1852 by Robert Angus Smith
- Refers to precipitation with pH less than 5.6
- Acidic material also deposited by dry particulate matter
- Causes mobilization cations in dissolution of iron precipitates in ferro-manganese crust
- Removes the color definition that is used to create sgraffito petroglyphs

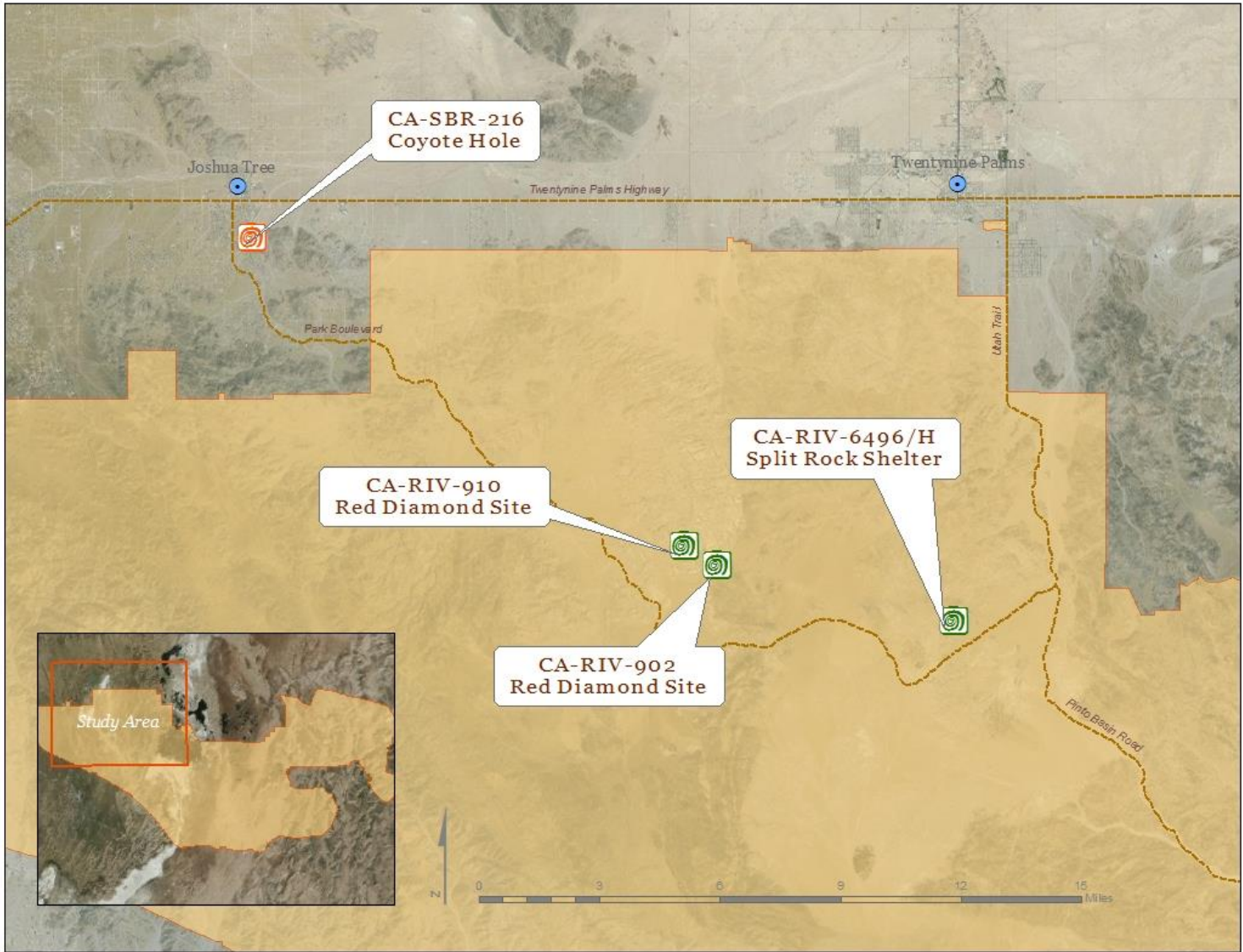




Must be one of those conservationist types.

Rock Art Conservation Management Study





A Tale of Two Management Plans

Joshua Tree NP

- Managed by NPS
- NPS Organic Act
- Most access restricted to park visitors
- Management style is based largely on site confidentiality

Coyote Hole

- Managed by SB Co. Flood Control
- Unrestricted access
- Signs, OHV exclusion
- Graffiti removal from MDLT

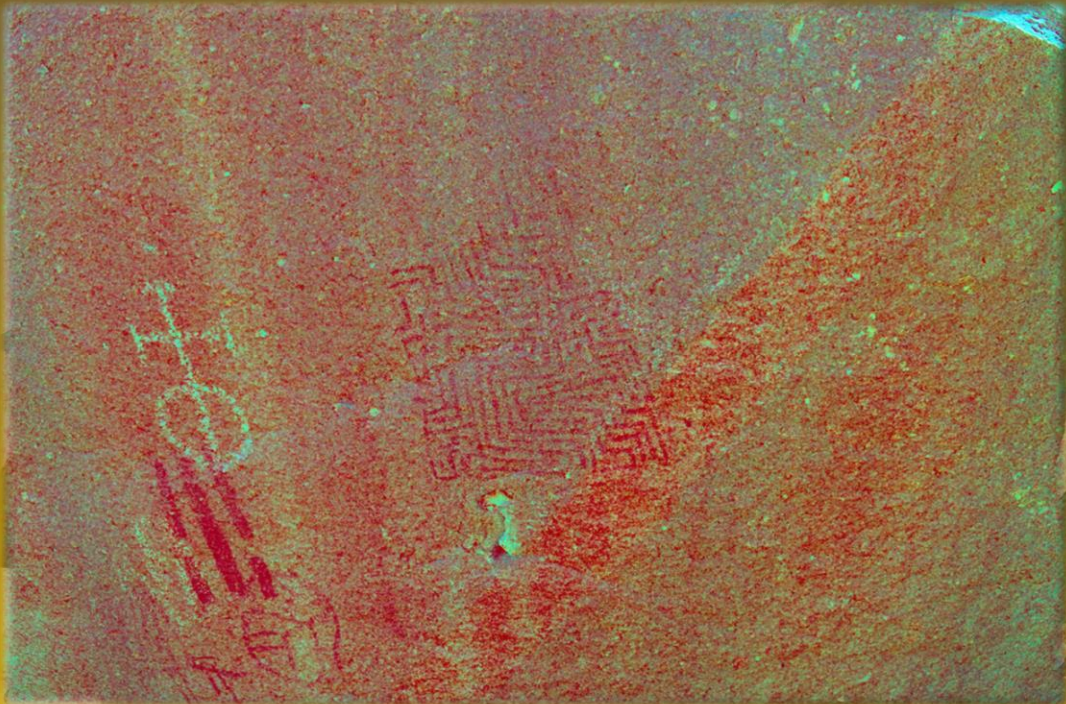
Coyote Hole Graffiti Remediation



Split Rock Graffiti “Treatment”



Test Sites: Infrequently Visited



CA-SBR-216 (SS 3)



CA-RIV-910 (Red Diamond)

Test Sites: Frequently Visited



CA-SBR-216 (SS 1)

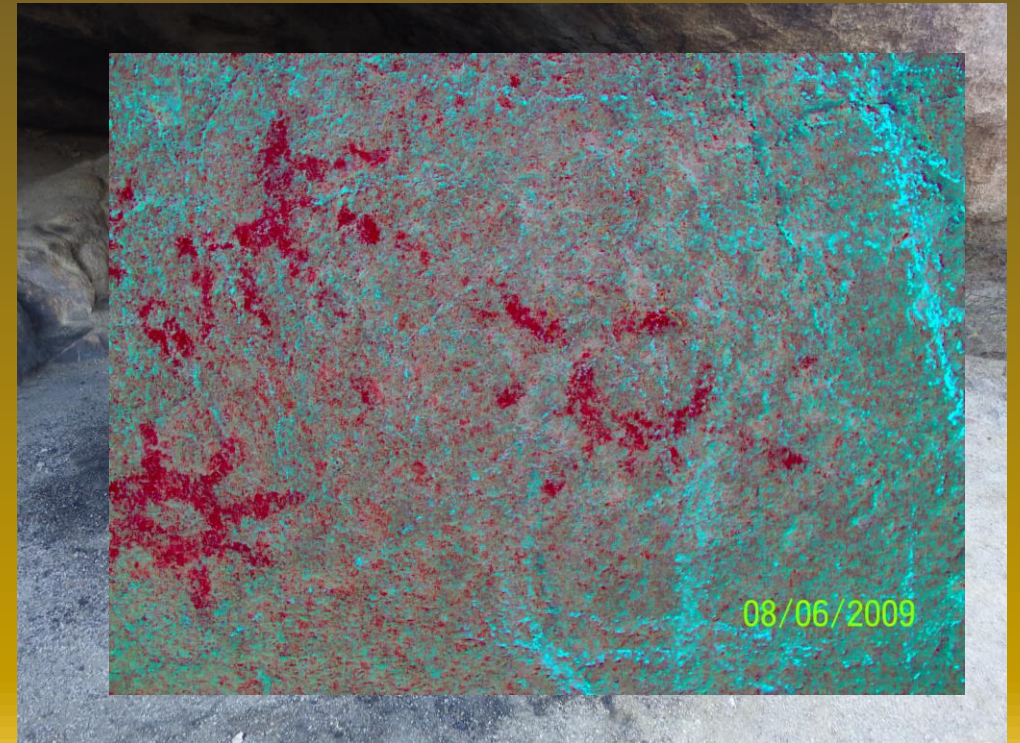


CA-RIV-910 (Red Lady)

Test Sites: Treated



CA-SBR-216 (SS 2)



CA-RIV-6496 (Split Rock)

Methods

Condition Assessments

- Transformational Processes (Biological, Chemical and Anthropogenic)
- Social Media Threat
- Rating system that rates the threat level

Rock Art Condition Assessment (Long)

Site Name: _____ Date: _____ Panel: _____
Site Number: _____ Start Time: _____ Finish Time: _____
ASMIS Number: _____ Observer(s): _____
GPS File Name: _____ UTM NAD 83; Zone 11 E _____ N _____

General Panel Description

G1. Type of support: Parietal Frieze Talus Clastic Tufa Earth figure Mobiliary
 Other Unknown

G2. Composition of support: Monzonite Basalt Granitic Limestone Sandstone Aggregate
 Other Unknown

G4. Overall setting: Rock Shelter/overhang Cave Open Air

G5. Geological setting: Canyon Drainage channel Hillside Terrace Mountaintop Floodplain
 Alluvial fan/Bajada Glacial deposit Inselberg

G6. Geological unit(s): _____

G7. Soil series: _____

G8. Total number of panels: n= _____

G9. Type of rock art:

G4a. <input type="checkbox"/> Pictograph	a. <input type="checkbox"/> Wet Application	b. <input type="checkbox"/> Dry Application
G4b. <input type="checkbox"/> Petroglyph	a. <input type="checkbox"/> Sgraffito	b. <input type="checkbox"/> Relief
G4c. <input type="checkbox"/> Earth form	a. <input type="checkbox"/> Intaglio/Geoglyph	b. <input type="checkbox"/> Petroform
	c. <input type="checkbox"/> Rock alignment	d. <input type="checkbox"/> Cairn

G10. Aspect (in degrees): _____; Panel angle (Face): _____ °

G11. Setting: Describe the overall setting of the site: _____

G12. History of disturbance/threats:

G9a. Public information available: Yes No Unknown

G9b. Media (check all that apply): Website Book Video Hiking/outdoor group Permitted commercial tour Park operated tour Illegal tour for profit Desert Institute course Park sign Word of mouth Other

G9c. Was the location identified?: Yes No Unknown

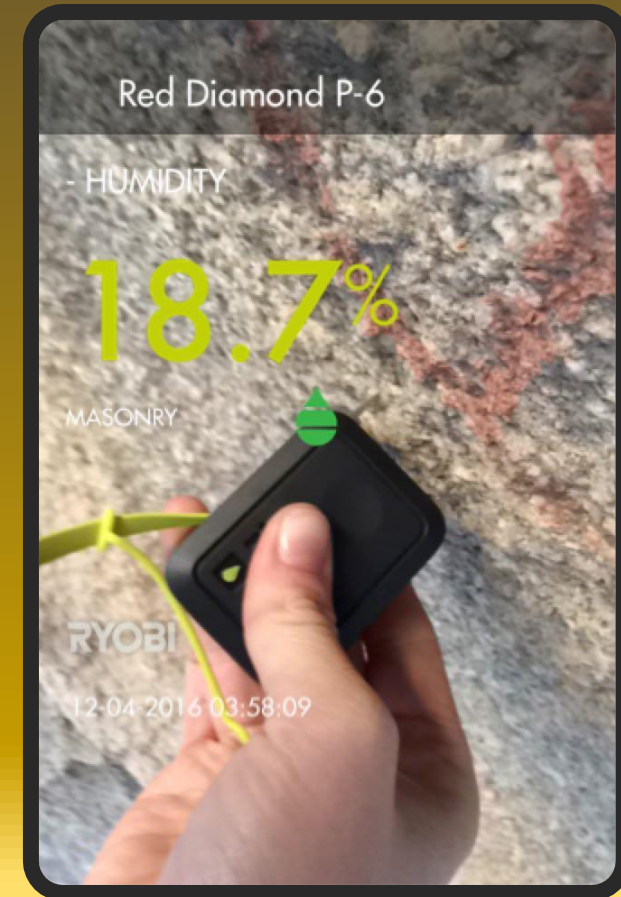
G9d. If identified, how?: Coordinates provided Topo/aerial map Directions Photographs Video

1

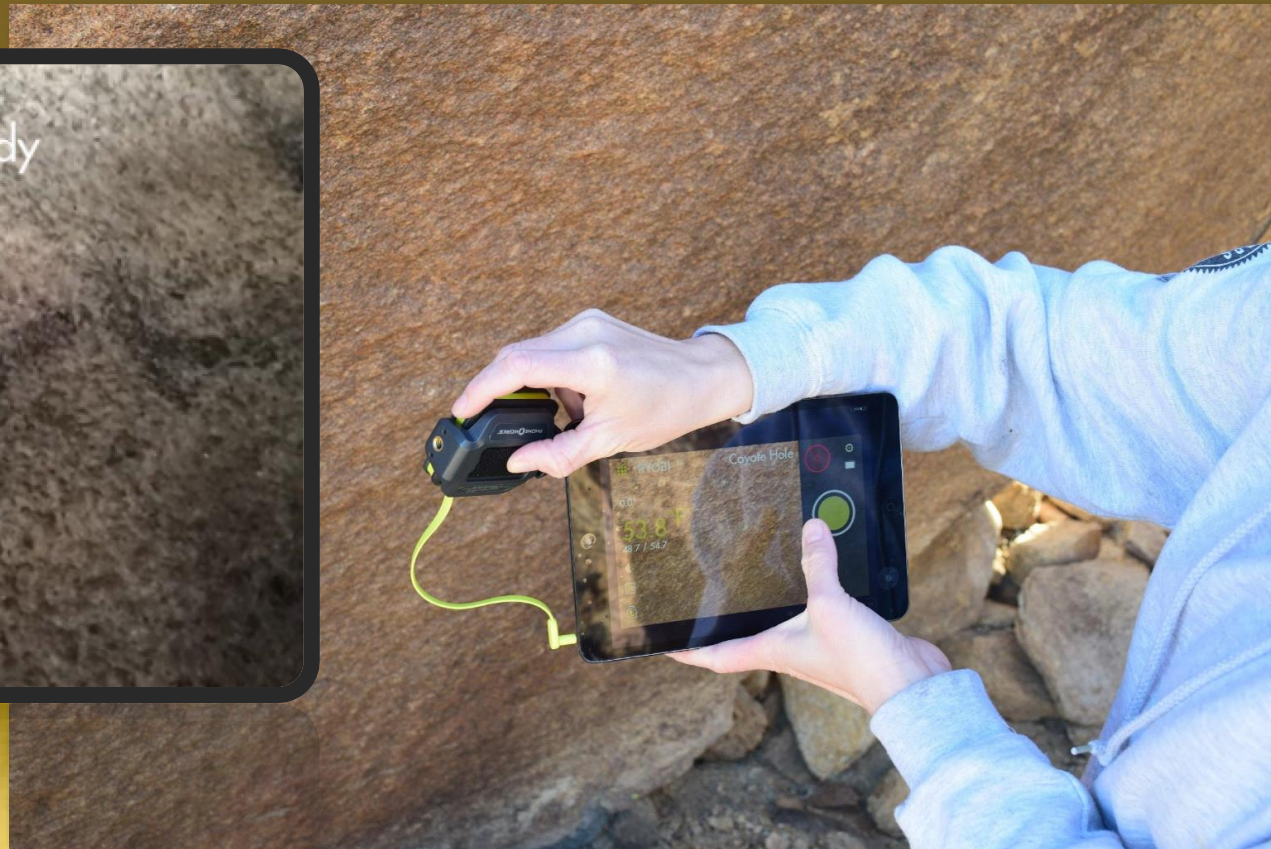
Aspect and Orientation



Moisture Content of Support



Surface Temperature



Color Monitoring



Light Intensity



Climatic Data

- Atmospheric Temperature
- Relative Humidity
- Wind speed
- Wind direction



Results

Scores

Coyote Hole

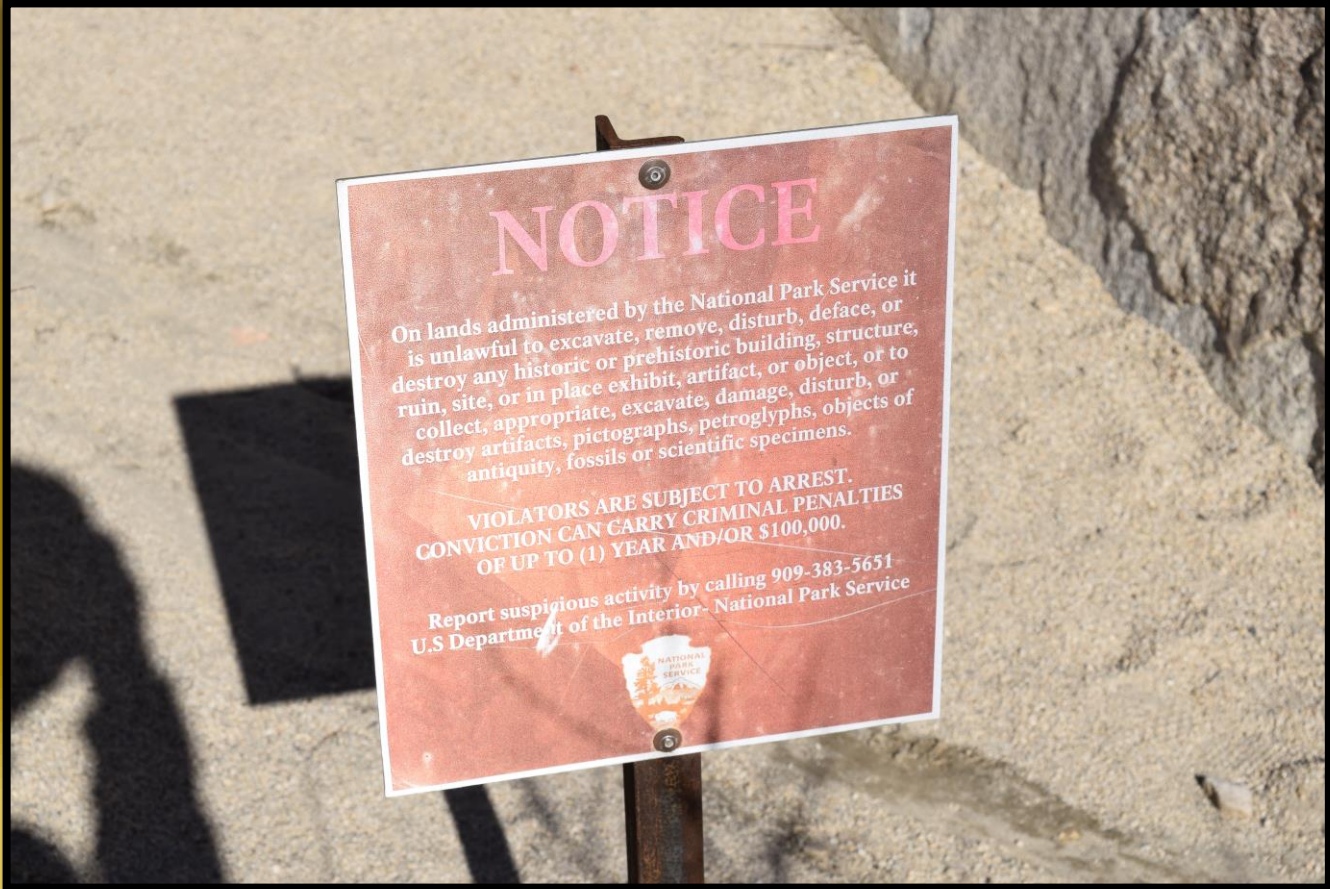
- SS 1 = 22 (severe)
- SS 2 = 15 (moderate)
- SS 3 = 45 (severe)

Joshua Tree N.P.

- CA-RIV-902 = 38 (severe)
- CA-RIV-910 = 12 (moderate)
- CA-RIV-6496 = 87 (severe)



SS 1



CA-RIV-902





SS 3



CA-RIV-6496

SS 1 Conservation Concerns

- Horizontal and vertical water flows
- Calcium Carbonate
- Fissuresols
- Erosion/deposition of sediment
- Visitor contact



SS 2 Conservation Concerns

- Vandalism
- Treatment with Elephant Snot
- Vertical water flows
- Erosion of subsurface deposits
- Rock varnish



SS 3 Conservation Concerns

- Vandalism
- Dogs/Coyotes
- Iron films
- Vertical water flows
- Mineral accretion



CA-RIV-902 Conservation Concerns

- Deflation/Erosion of shelter floor deposits
- Chalk from climbing
- Calcium Carbonate
- Calcium Oxalate
- Aeolian Abrasion



CA-RIV-910 Conservation Concerns

- Salt erosion
- Case hardening
- Vertical water flows



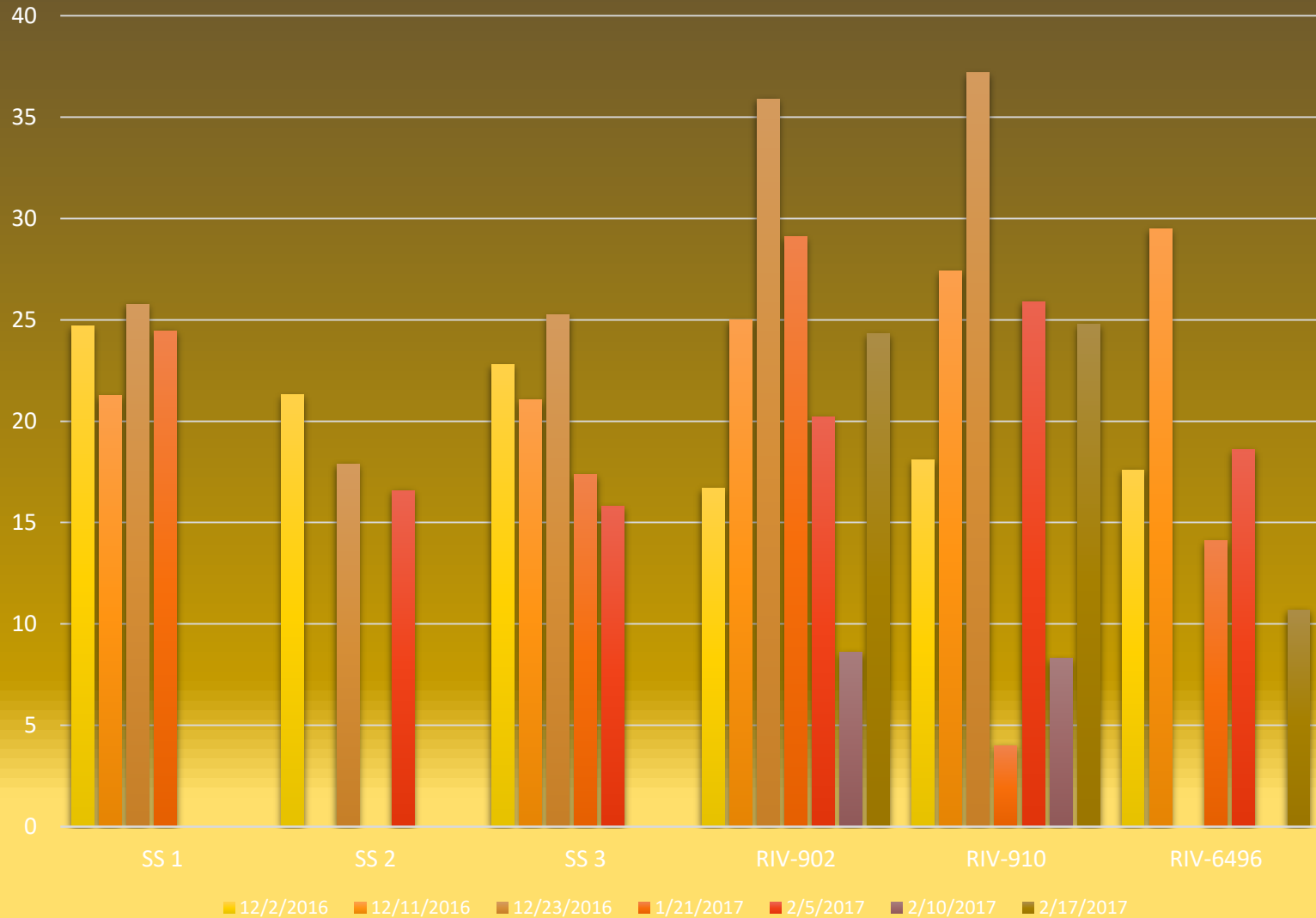
CA-RIV-6496 Conservation Concerns

- High visitation
- Vandalism
- Campfires
- Hygroscopic expansion of particulates
- Disturbance to subsurface deposits

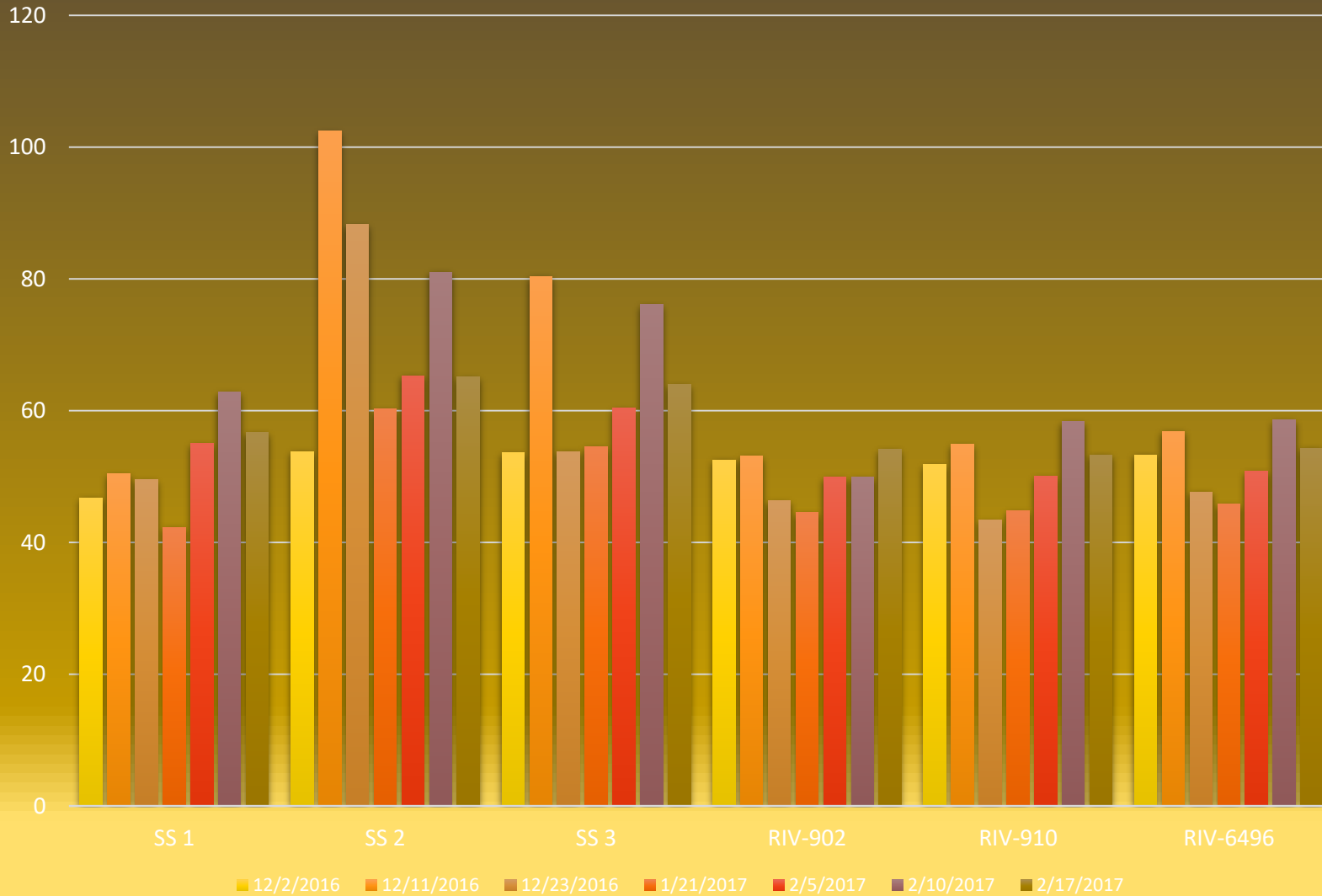


Site Comparisons

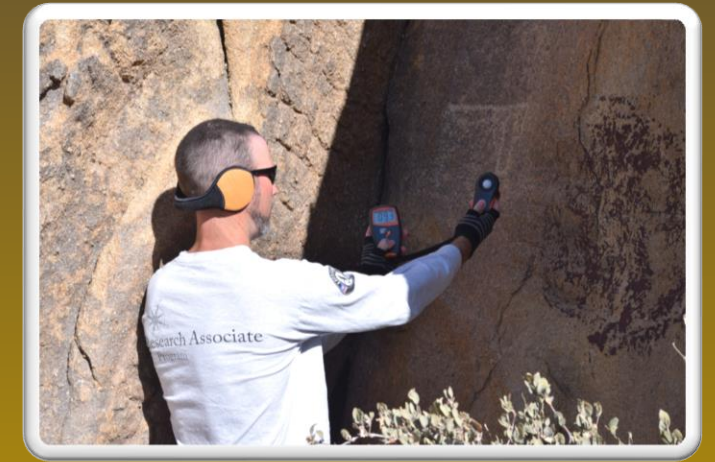
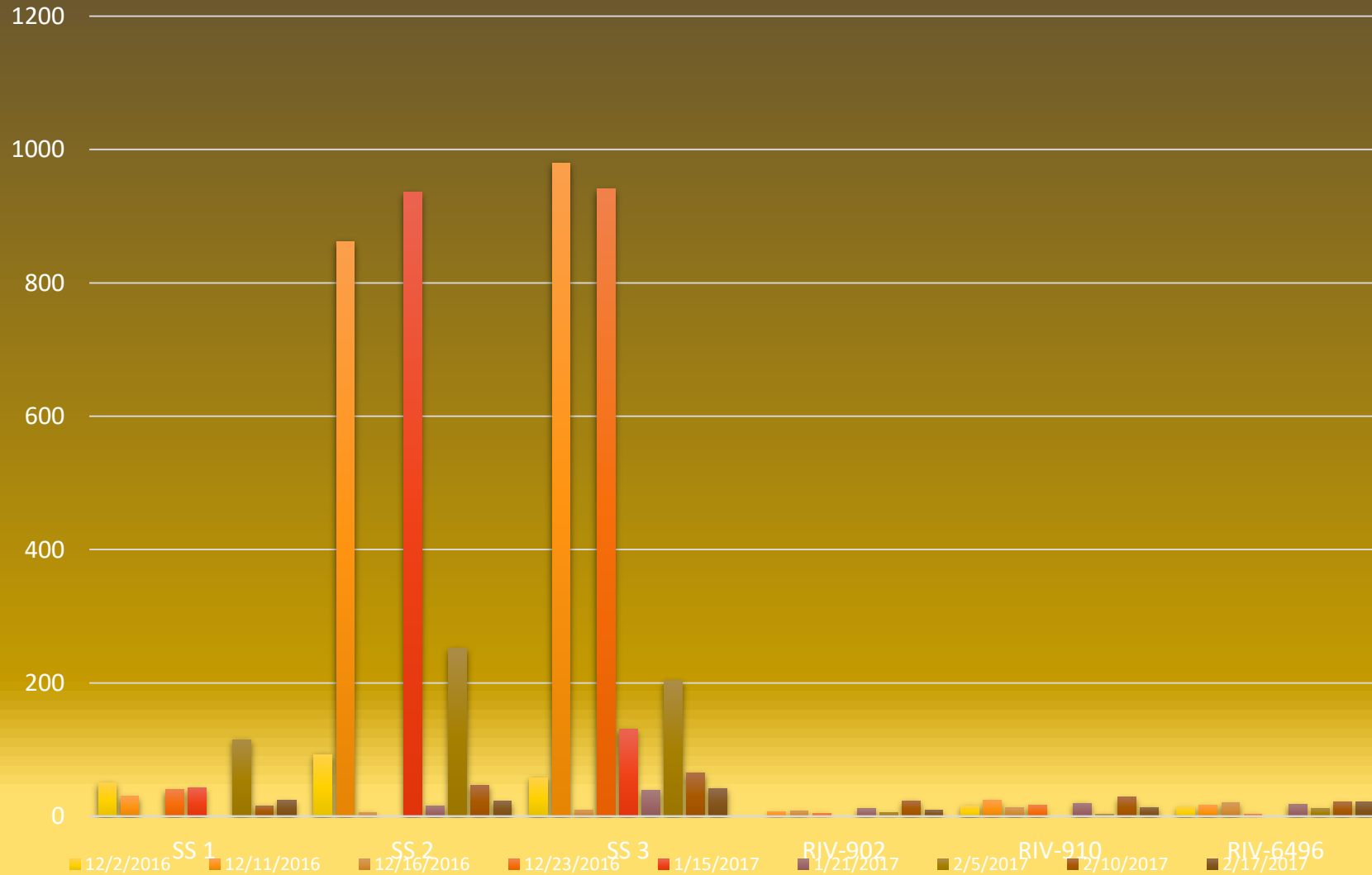
Moisture Content of Support by Site



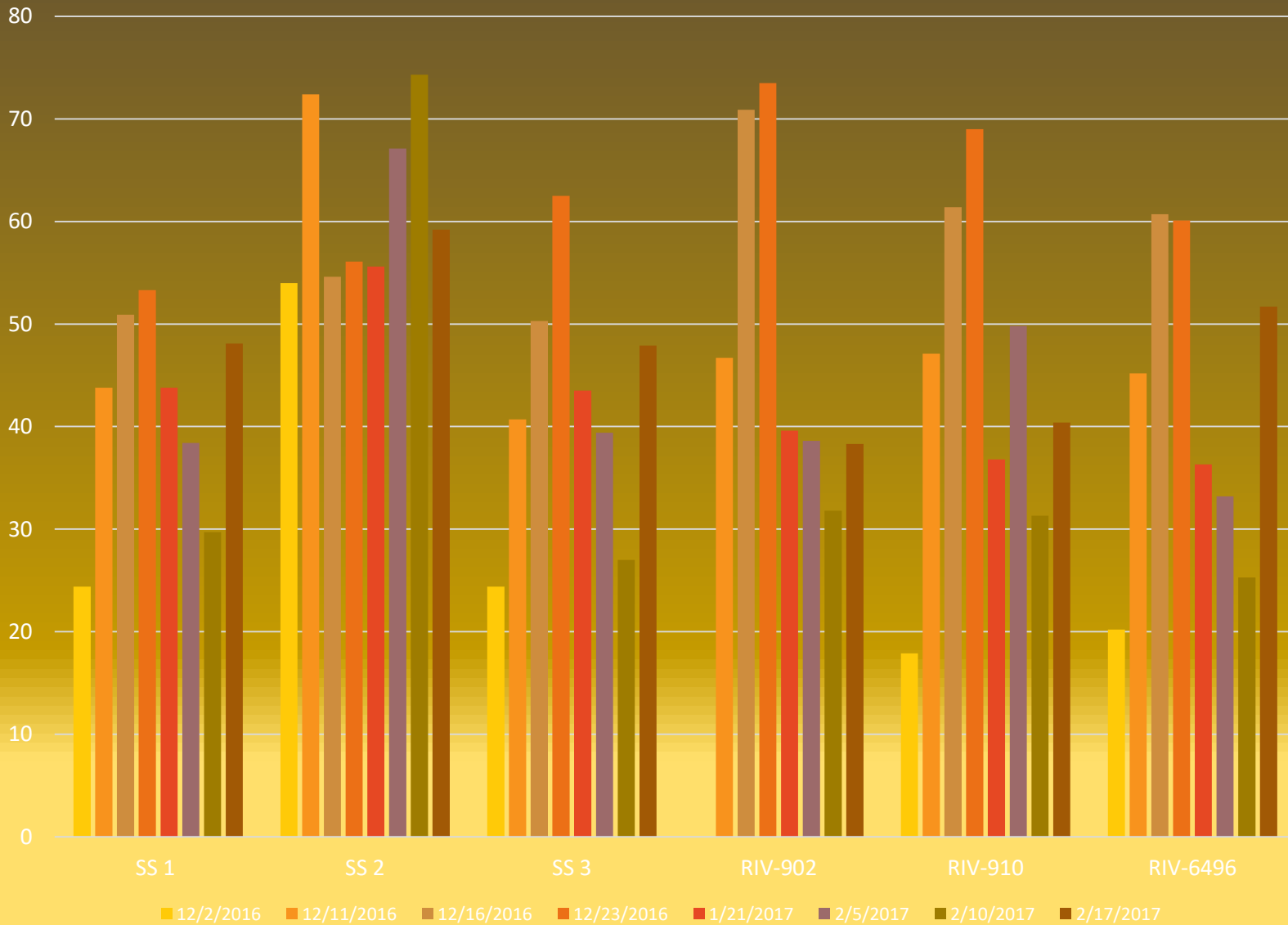
Average Surface Temperature by Site



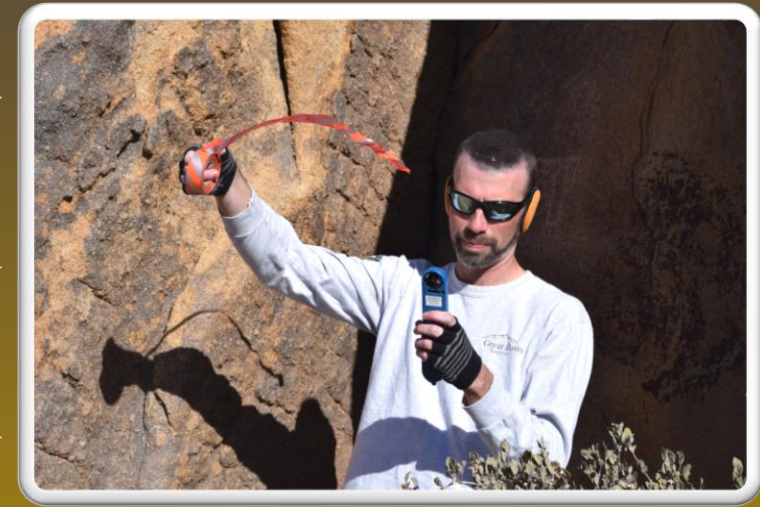
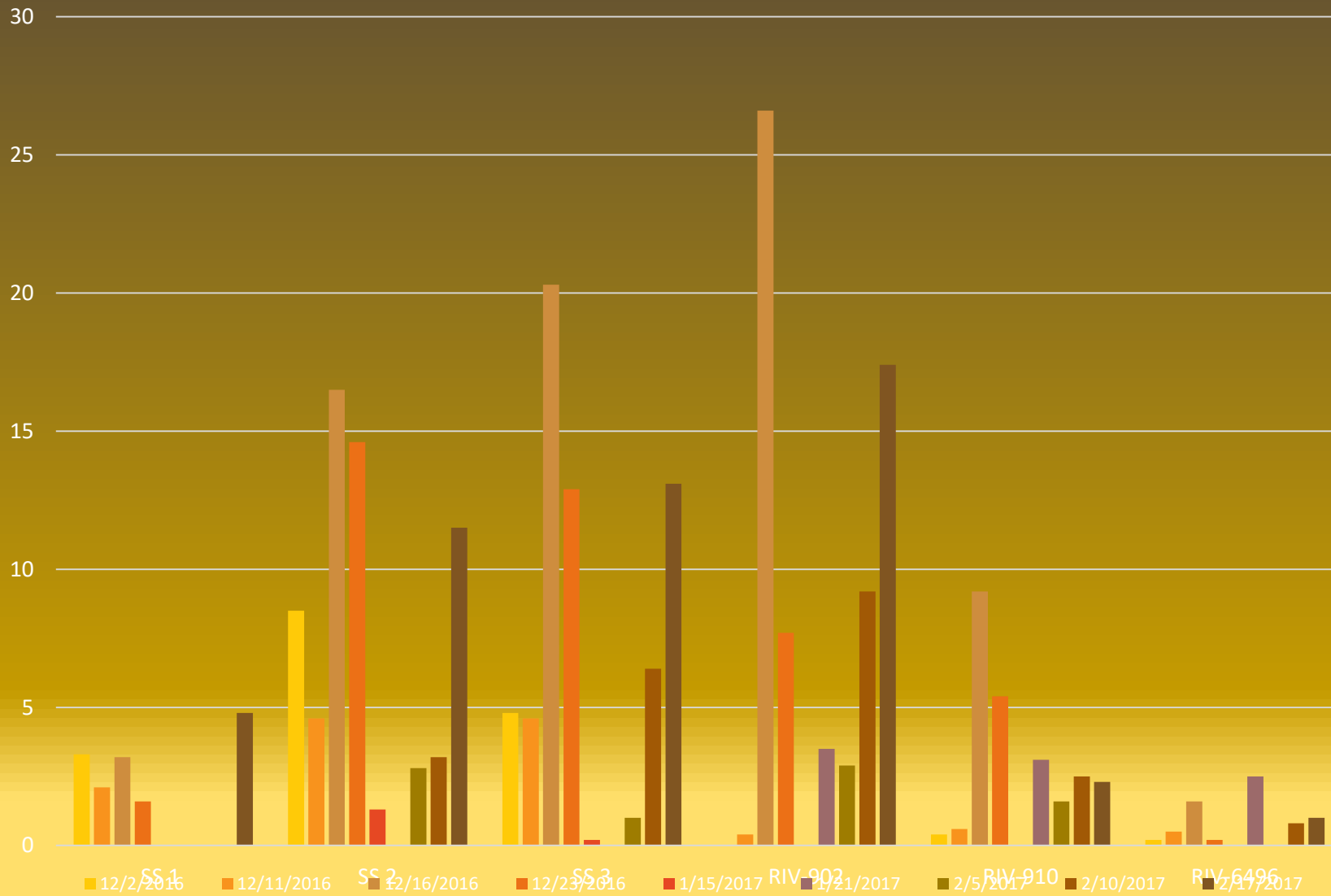
Light Intensity by Site



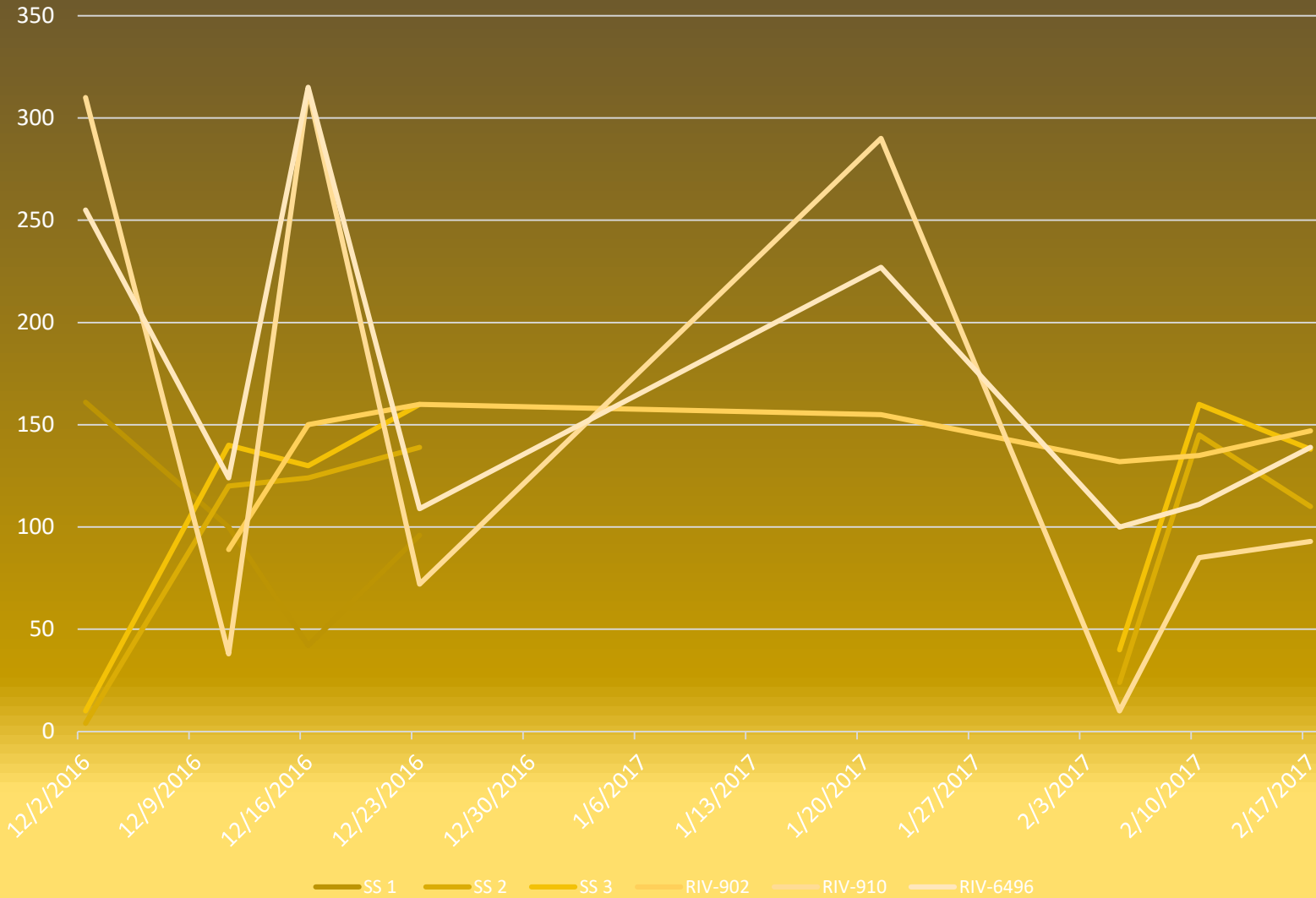
Relative Humidity by Site



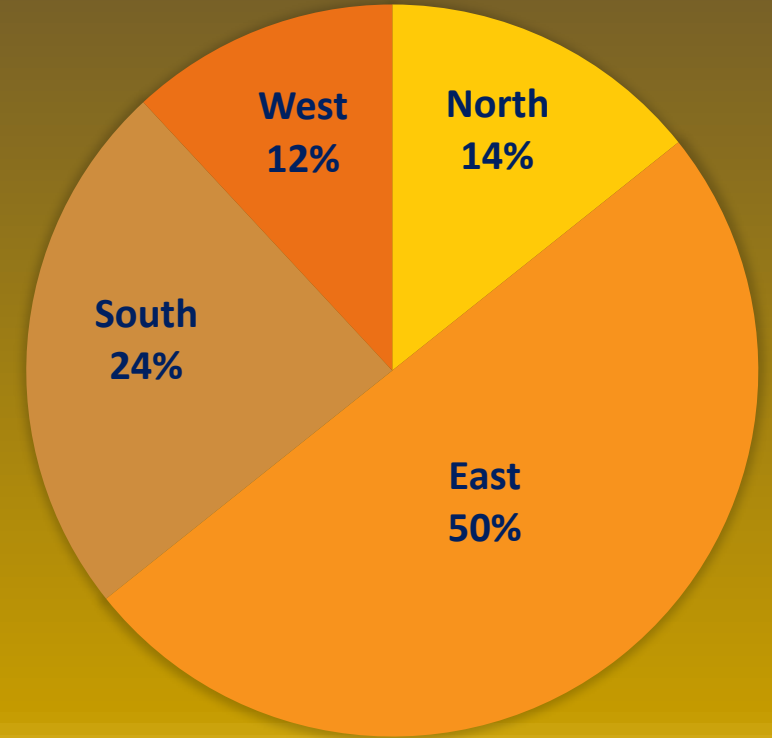
Wind Speed by Site



Wind Direction by Site



Wind Direction



Break



TAKE OUT THAT PART?! ARE YOU NUTS?
HOW IS THE STAMPEDE SCENE AT THE
END OF THE CAVE GOING TO MAKE
SENSE WITHOUT IT?!

CARTOONSTOCK.com

Search ID: wml100125

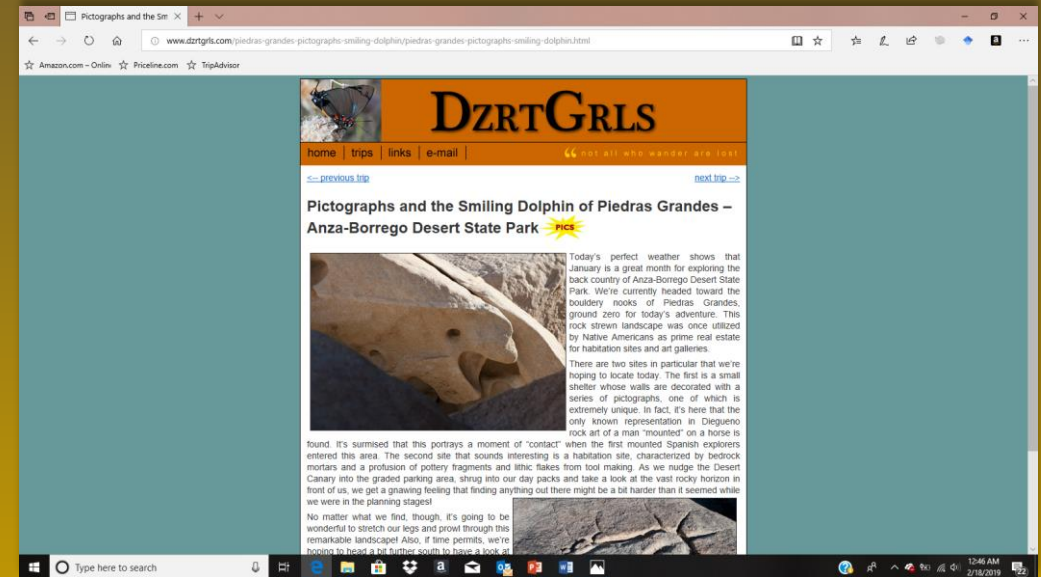
THE FIRST WRITER *and* EDITOR

Monitoring and Data Collection

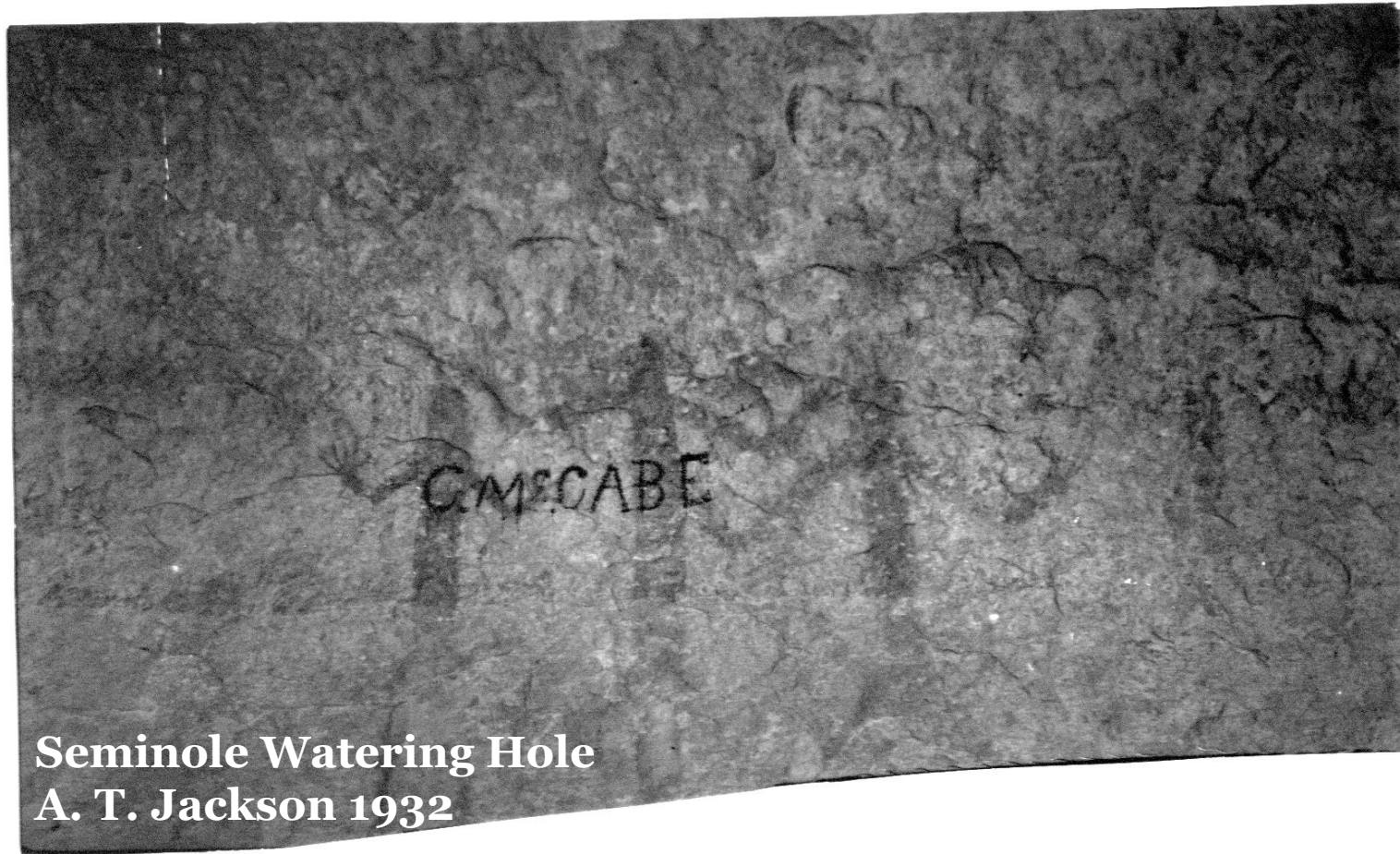
- **Passive Data Collection**– data collected continuously in absence of researcher
- **Active Data Collection**– require real-time collection of data by researcher

Conduct an Internet Search

- Search through social media, Facebook, twitter, blogs and Youtube videos to see what information is available for the site
- Identify which ones provide location information
- Monitor blogs periodically



Legacy Photographs



**Seminole Watering Hole
A. T. Jackson 1932**



Condition Assessments

- Establish Baseline Data
- One-page summaries are too broad
- Data should be sufficient so as to be able to document diachronic change
- Establish rating system
- Rate sites on their level of risk
- Focus on sites that exhibit the greatest threat level

Rock Art Condition Assessment (Long)

Site Name: _____ Date: _____ Panel _____
Site Number: _____ Start Time: _____ Finish Time: _____
ASMS Number: _____ Observer(s): _____
GPS File Name: _____ UTM NAD 83; Zone 11 E _____ N _____

General Panel Description

G1. *Type of support:* Parietal Frieze Talus Clastic Tufa Earth figure Mobiliary
 Other Unknown

G2. *Composition of support:* Monzonite Basalt Granitic Limestone Sandstone Aggregate
 Other Unknown

G4. *Overall setting:* Rock Shelter/overhang Cave Open Air

G5. *Geological setting:* Canyon Drainage channel Hillside Terrace Mountaintop Floodplain
 Alluvial fan/Bajada Glacial deposit Inselberg

G6. *Geological unit(s):* _____

G7. *Soil series:* _____

G8. *Total number of panels: n=* _____

G9. *Type of rock art:*

G4a. <input type="checkbox"/> Pictograph	a. <input type="checkbox"/> Wet Application	b. <input type="checkbox"/> Dry Application
G4b. <input type="checkbox"/> Petroglyph	a. <input type="checkbox"/> Sgraffito	b. <input type="checkbox"/> Relief
G4c. <input type="checkbox"/> Earth form	a. <input type="checkbox"/> Intaglio/Geoglyph	b. <input type="checkbox"/> Petroform
	c. <input type="checkbox"/> Rock alignment	d. <input type="checkbox"/> Cairn

G10. *Aspect (in degrees):* _____ °; *Panel angle (Face):* _____ °

G11. *Setting:* Describe the overall setting of the site: _____

G12. *History of disturbance/threats:*

G9a. Public information available: Yes No Unknown

G9b. Media (check all that apply): Website Book Video Hiking/outdoor group Permitted commercial tour Park operated tour Illegal tour for profit Desert Institute course Park sign
 Word of mouth Other

G9c. Was the location identified?: Yes No Unknown

G9d. If identified, how?: Coordinates provided Topo/aerial map Directions Photographs
 Video

1

Examine the Panel



- Closely examine the panel for any current or potential threats to the panel
- Closely examine the immediate environment in which the panel is located for exterior threats
- Examine the ground surface for threats to the subsurface deposits
- Try to be thorough

Photo Documentation

- Photo document everything no matter how trivial
- Photo document every site visit even if there are no perceived changes
- Take overall photos and close-up photos
- Quantity is more important than quality
- Your photograph may be the last time a photo was taken before a sudden change



Visit Each Site During Variable Weather Conditions

- Visit the site when it's:
- Sunny and cloudy to study the sun exposure patterns
- Hot and cold to understand the panel temperature variation
- Windy and calm to understand the wind patterns
- Rainy and dry to understand the hydrological patterns



Visit Each Site at Different Times of the Day and Year

- Visiting the site during different times of day will help understand **diurnal patterns** such as temperature and light variation
- Visiting the site at different times of year provides understanding of **annual changes** in light angles, atmospheric temperatures, and humidity



Aspect and Orientation



Aspect and Orientation



Structure from Motion Photogrammetry

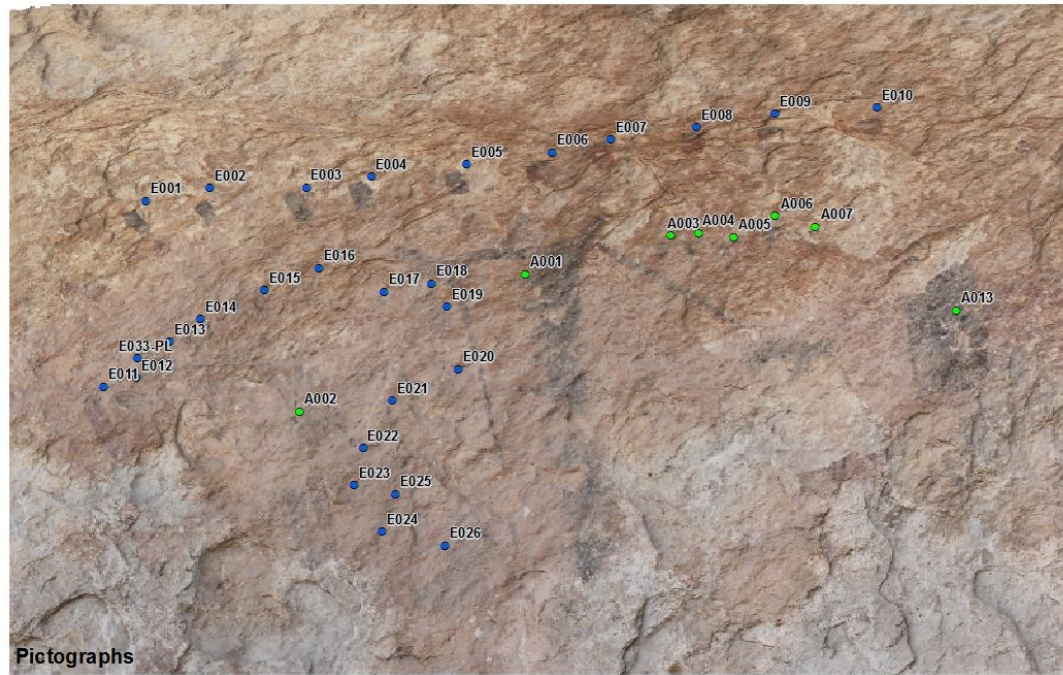


3D Models for Site Monitoring



Collect Spatial Data

41VV0167 - Eagle Cave Figure Map



Panel Moisture Content

- Use a protimeter (i.e. moisture meter) to take readings
- Can be recorded on data sheet
- Some devices save data
- Data should be collected during each site visit
- Data should be collected at regular intervals along panel
- Never place prongs directly on imagery



ROCK SUBSTRATE MOISTURE MONITORING FORM

Site #: _____ Site Name: _____ Date: _____



Field Crew: _____

Rock Substrate Moisture Identification Number	Time	Photograph jpeg #	Moisture Content Lower Register	Moisture Content Upper Register	Comments: (overall condition, how is it affecting the rock art?, any observed exfoliation?, potential impact on rock art if untreated, how has it changed since the last documentation?, last date documented, treatments performed, etc.)
RSM001					
RSM002					
RSM003					
RSM004					
RSM005					
RSM006					
RSM007					
RSM008					
RSM009					
RSM010					
RSM011					
RSM012					
RSM013					
RSM014					
					Page ____ of ____
RSM015					
RSM016					
RSM017					
RSM018					
RSM019					
RSM020					
RSM021					
RSM022					
RSM023					
RSM024					
RSM025					
RSM026					

Light Intensity

- Use a light meter measuring in LUX
- Collect data along panel or at multiple panels
- Orient instrument with the panel orientation
- Take readings during every site visit
- Try to collect readings during different times of the day and different times of year



LIGHT INTENSITY MONITORING FORM

Site #: _____ Site Name: _____ Date: _____



Field Crew: _____

Light Intensity Identification Number	Time	Photograph jpeg #	Light Intensity (LUX)	Setting	Comments: (overall condition, how is it affecting the rock art?, any observed exfoliation?, potential impact on rock art if untreated, how has it changed since the last documentation?, last date documented, treatments performed, etc.)
LI001					
LI002					
LI003					
LI004					
LI005					
LI006					
LI007					
LI008					
LI009					
LI010					
LI011					
LI012					
LI013					
LI014					
LI015					
					Page _____ of _____
LI016					
LI017					
LI018					
LI019					
LI020					
LI021					
LI022					
LI023					
LI024					
LI025					
LI026					
LI027					

Panel Surface Temperature

- Use infrared thermometer
- Can be Celsius or Fahrenheit (**be consistent**)
- Take readings during every visit
- Take readings across the entire panel
- Take readings at different times of day and year



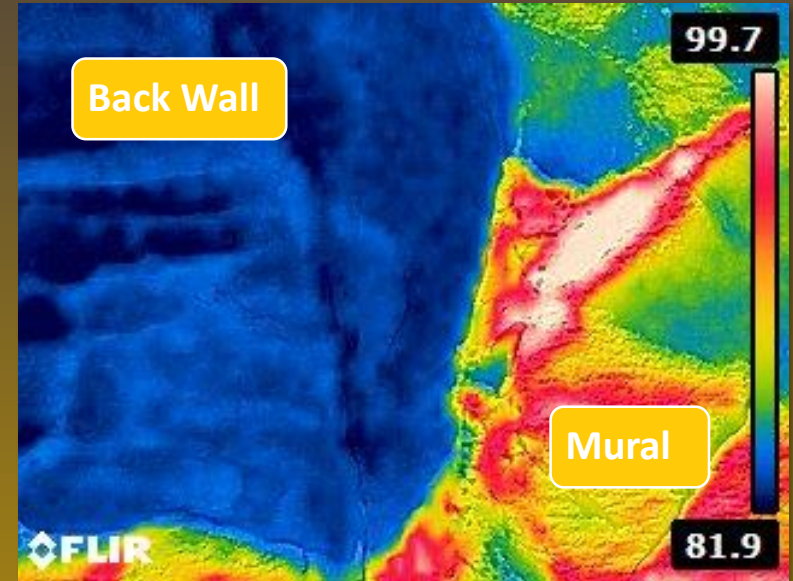
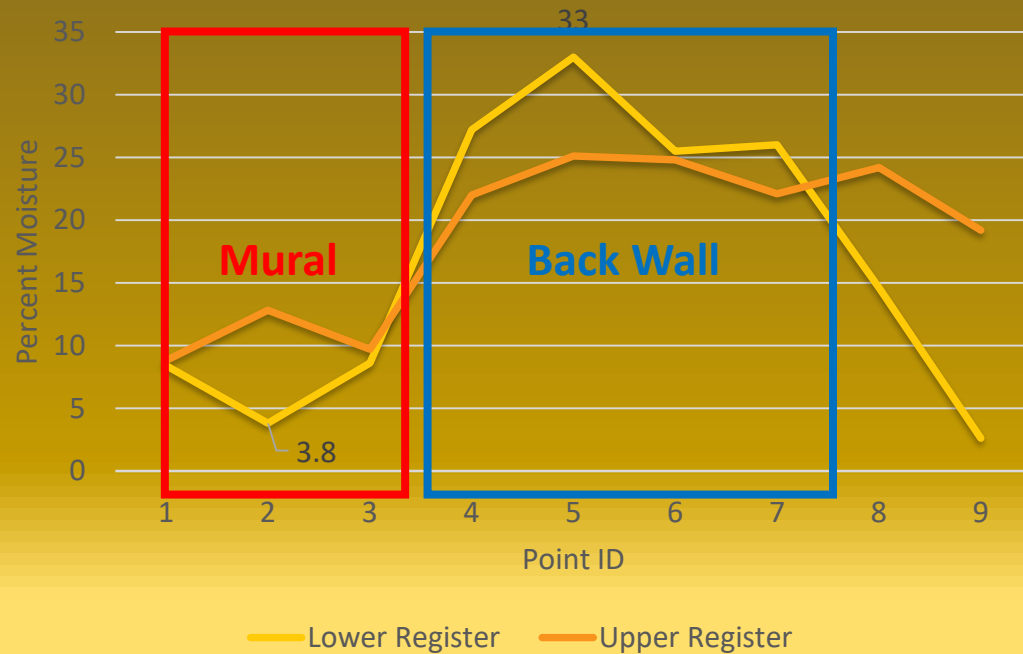
Temperature Variation

- Use a thermal imaging camera
- Take overall and close-up photos
- Use during every site visit
- Combine data with infra-red thermometer data



Combined Methods

White Shaman
Rock Substrate Moisture Content
October 1, 2014



Microscopic Analysis

- Clastic wear or polish
- Differentiating iron films from paint
- Mineral accretion
- Pitting
- Abrasion marks
- Fissuresols



Color Monitoring

- Record baseline color and periodic checks to monitor color change
- Munsell Color Chart can be used
- Colorimeter technological application



Climatic Monitoring



Continuous or Periodic

- Temperature
- Wind Speed
- Wind Direction
- Relative Humidity
- Rainfall

Aeolian Dust Capture

- Shepherd's hook with fly-paper tied to it to capture particulate dust particles
- Tray with marbles
- Can be left at site and retrieved to better understand the role of particulate matter



pH of Sediment

- Use a soil pH meter to record the pH of the sediment with a rock shelter or the immediate vicinity of open-air panels
- Acidic sediment affixed to a panel can contribute acidic solution during rain events
- This can lead to mobilization of iron compounds in rock surface

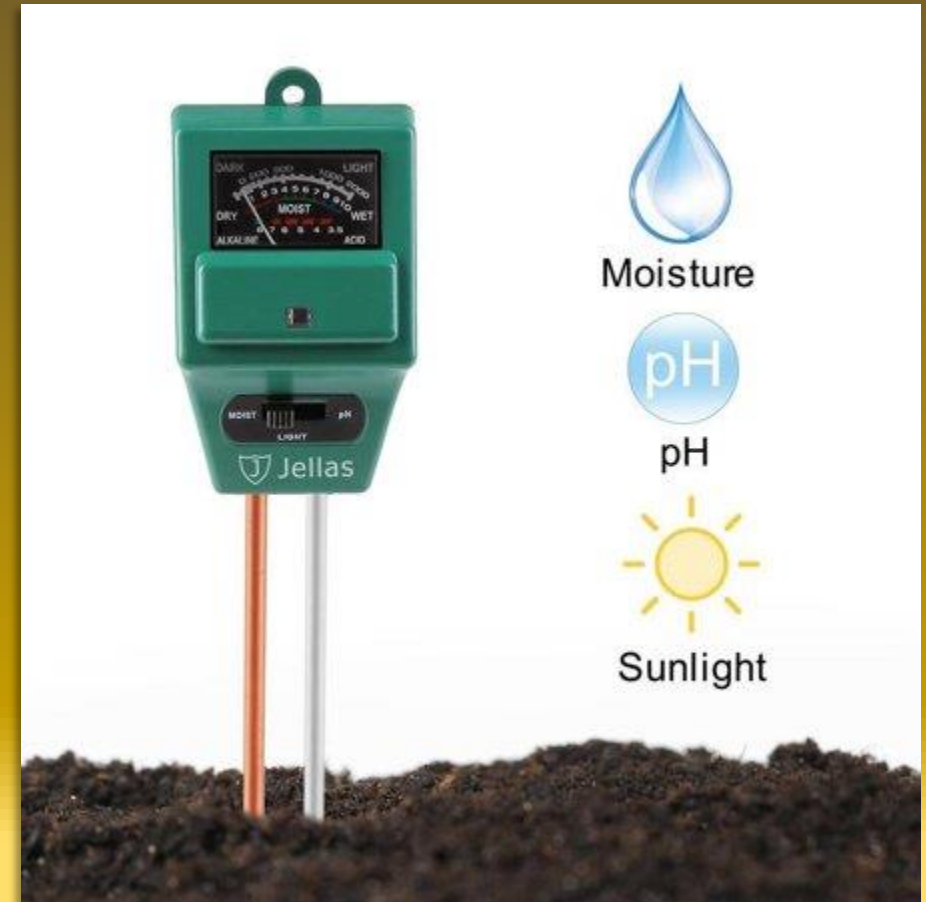


Photo Document Footprints

- Identify ingress/egress
- Try to determine how many people visited site
- Use as evidence of site visitation particularly for non-disclosed sites



Know Who is Visiting the Site

- Game cameras can be an inexpensive way to photo document human and animal traffic at site
- Ensure that camera is in **concealed** location
- Data can be downloaded off SD card periodically
- Can be useful in potential ARPA cases



Determining what visitors know

- Try to discern how/where visitors get information about non-disclosed sites
- This is a good indicator if **site confidentiality** is an appropriate means of site protection
- Knowing what information is available and how people access it can be crucial when preparing a management plan



Determining Who Visits Sites and How They Interact with Sites



Red L

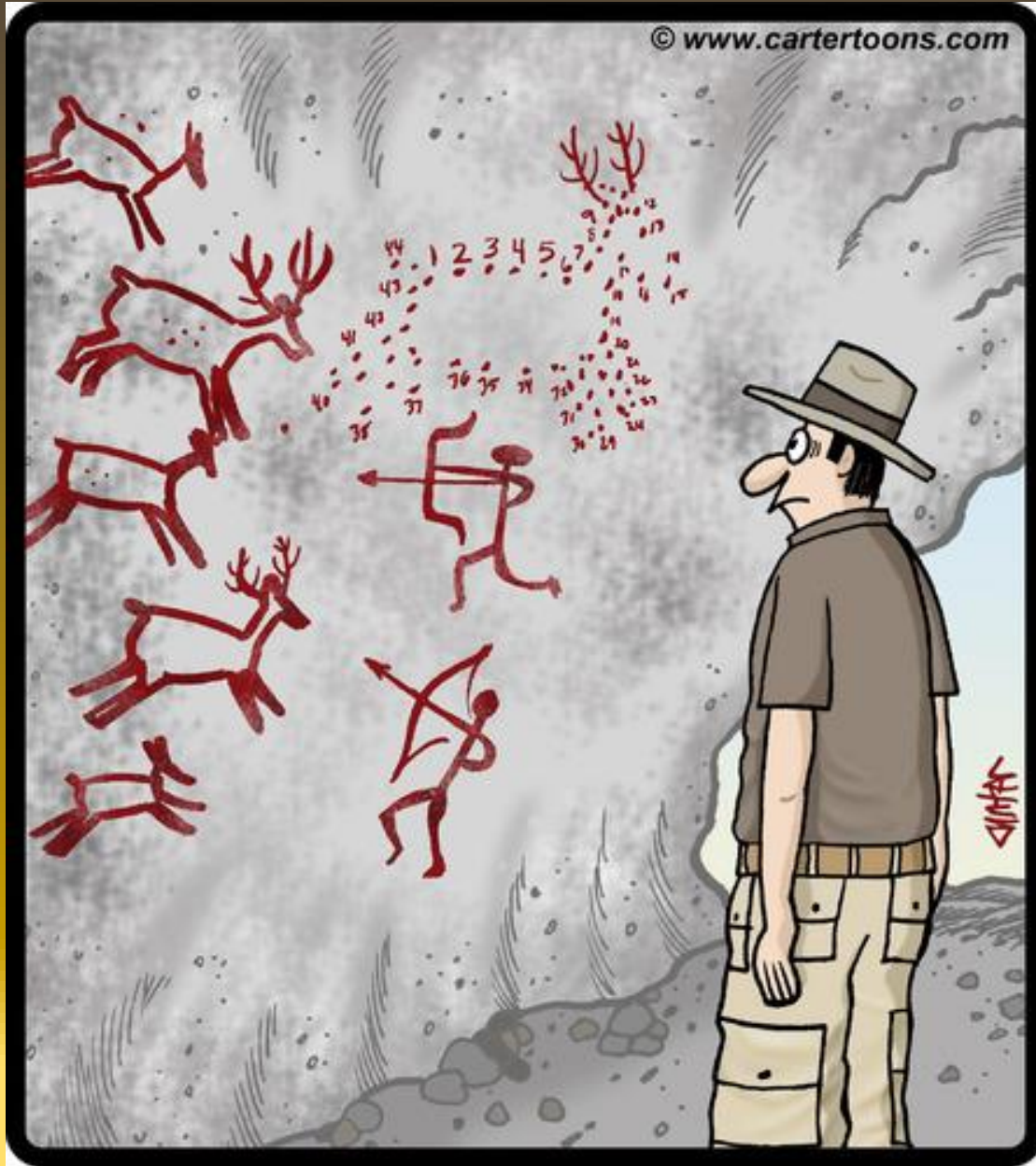
- Determine who is visiting a site and for what purpose
 - Taking photos
 - Vandals
 - Partying
 - New Age Religion
 - Illegal commercial tours
- Try to take photos if possible

Data Storage

- Download data captured on devices into a common project folder for each site
- Digitize data (e.g. spreadsheet, etc.) that is hand-written on forms
- Digitize forms used to record data and notes
- Download all photos and save them in dated folders



Intervention Methods



Non-destructive Documentation

Use Non-intrusive Documentation Practices

- You are not the first to document a site nor will you be the last, respect the resource
- Follow ARARA guidelines for documentation
- Where possible use practices that are non-intrusive
- **Never** stick your IFRAO scale to a rock art panel



Always Follow Proscribed Etiquette

7 of 11

NOT To Do List: Guides and Visitors

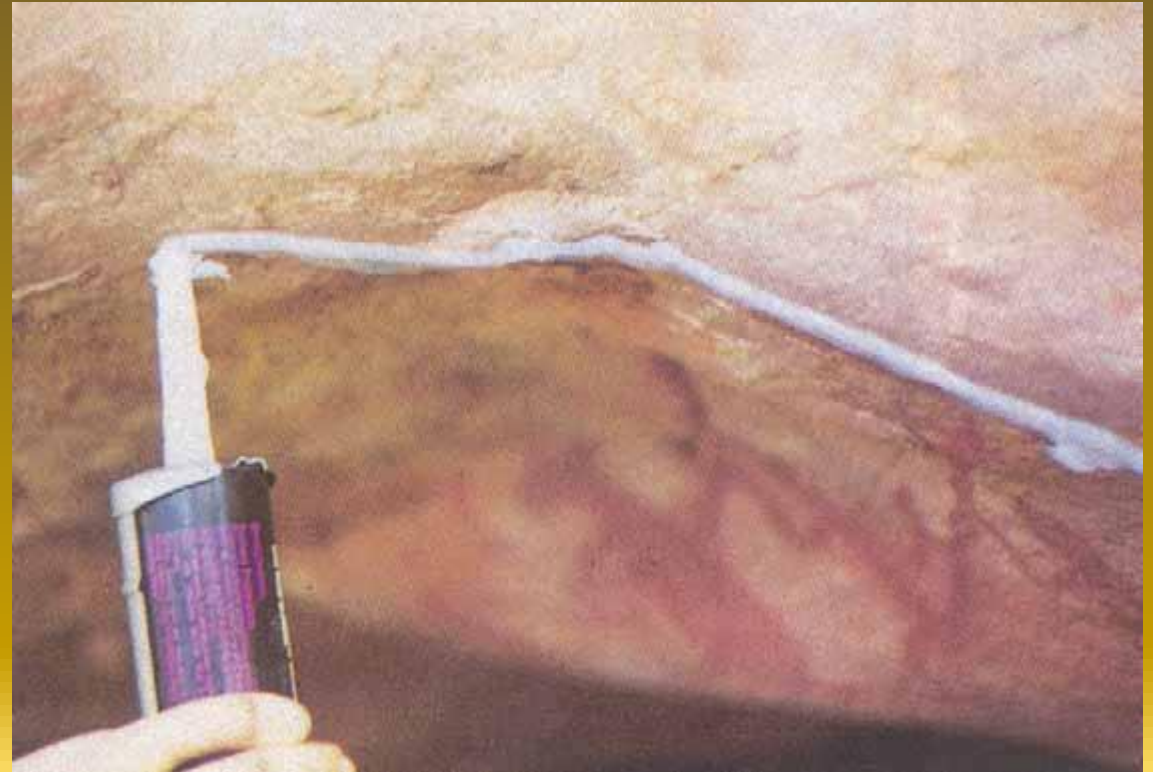
- 1. Stay off ALL rock art.**
 - a. No walking, leaning, or climbing on panels, boulders, or cliffs as this causes scratches and deterioration from shoes, hands, and walking sticks.
- 2. Do not touch the rock art.**
 - a. Direct contact with the rock art results in oils from your hands increasing the natural deterioration process of the rock that can add to the site's destruction and contaminate the figures for future chemical analysis. Hand oils also stain and wear away the rock art through abrasion.
 - b. Do not trace pictures with sticks or other abrasive pointers to indicate figures.
- 3. Do not disturb the setting, which is part of the rock art site.**
 - a. Do not leave trash.
 - b. Do not start campfires near rock art panels.
 - c. Do not collect rocks, artifacts, plants.
 - d. Do not disturb the ground around and below the site.
 - 1) This area may contain cultural materials that provide information about the site age and function.
 - 2) Loose sediments in this area may create a dust cover on the rock art.
- 4. No physical enhancement of the rock art.** This speeds natural deterioration, destroys the figures for future dating, and is often inaccurate changing the form of the figure. Additionally, substances are disrespectful to the rock art.
 - a. **Physical enhancement includes:**
 - 1) Chalking, whether to fill in or outline figures.
 - 2) Painting squares or circles around figures.

5:04 PM
2/10/2019

Mitigating Effects of Water

Artificial Dripline

- Applying a ribbon of silicon at the dripline of a rock shelter to prevent water from running over a panel
- Can be applied with standard gun
- Angle towards the panel
- Cut the tip of the nozzle to create a beveled edge



Water Diversion

- Re-channel natural drainage trough to avoid impacts to site
- Water should not be diverted in such a way that may impact other subsurface sites



Protective Shelters

- Can be used on open-air sites
- Caution should be used so as not to alter microclimate
- E.g. installing a plexiglass panel in front of a panel could change the humidity levels on the panel



Kelly's Island, Ohio

Lithobiont Removal

Monitor Lichen

- Determine the species of lichen
- Determine how it may affect the support
- Monitor the site for a period prior to treatment to determine if lichen is adversely affecting support
- If adverse effect examine options for removal
- If unable to determine effect of lichen it is best to **leave it be**



Mechanical Removal

- Wire brush or soft bristle brush can be used to remove lichen
- Picking at it using tweezers
- Risk of removing paint
- May leave spores that develop more lichen colonies
- May result in rock crumbling



Chemical Removal

- Solution of 50% alcohol (either ethanol or isopropanol) and 50% deionized water
- Dehydrates and kills lichen
- Biocides cause discoloration of rock
- Bleach and/or toxic chemicals should be avoided



Light Exposure/Deprivation

- Depriving lichen of light by covering with sand or black plastic sheeting
- Using reflected light to flood lichen with sunlight
- Covering a panel with sand adds coarse particulates
- Covering with black sheeting can increase humidity



Vegetation Management

Vegetation Management

- Should only be removed if adversely affecting rock art
- Adverse effects of removing vegetation should be examined prior to removal
- Consideration given to indigenous communities that may be affected if removed



Considerations of Vegetation Removal

- Change the micro-environment
- Expose panel to increased sunlight resulting in growth of lichen or algae
- Lead to increased evaporation leading to increase in humidity
- Increased erosion of archaeological deposits
- Removes natural wind block
- Makes a site more conspicuous to visitors



Vegetation Management

- Vegetation should be trimmed back to avoid abrasion of panel
- Removing vegetation adjacent to panel may be preferable for wildfire management
- Vegetation growing in fissures can be trimmed down to stem
- Herbicides can be used to remove vegetation growing in fissures
- Organic compounds should never be used on rock art panel



Animal Control

Fences

- Fence can prevent animals from entering site
- Should be high enough and sturdy enough for variety of animals
- Installation should minimize impact to subsurface deposits
- Should be monitored frequently
- Floor grids have also been used to prevent animals from entering sites



Animal Dung

- Can be removed by picking at it
- Diluted solution of water and alcohol can be applied with cotton swab
- Swab should be rolled over surface rather than rubbed
- Rubbing can create abrasive forces and rub matter into rock surface



Removal of Bird Droppings

- Use water and non-ionic detergent (e.g. Lissapol)
- Dab solution on affected area to remove droppings
- Dry brush can be used when using water may affect rock art
- Place drop cloth to capture loosened debris



Removal of Mud Nests

- Wire brush, putty knife, or dental pick for mechanical removal
- Start by removing outer portion of nest working towards panel
- Be careful not to remove paint with nest
- Soft bristle brush can be used to remove what remains



Eradicating Mud Daubers

- Simply removing nests will not terminate mud dauber concerns
- Suitable environment made of wood can be created to divert mud daubers from panel
- Mud daubers prefer the wood supports
- Once mud daubers revert to wood structure then eradicate them
- Attracting wasp eating birds (e.g. purple martins)



Eradicating Termites and Ants

- Destruction of mounds or nests within 50 m of panel
- Nests should be dug out and queen killed
- Nests in trees and logs within 50 m of panel should be destroyed
- Create chemical barrier by treating strip of soil with insecticides



Salt Removal

Flushing Salt

- Flush area by lightly spraying with water
- Run-off should be capture to prevent erosion of panel or subsurface deposits
- This method can dissolve salt which may re-precipitate deeper in support
- Also introduces water into pores and cavities

Poultice

- Poultice made of hemp paper
- Dry sheet of paper is placed over area to be treated
- Water is applied to paper with spray bottle until paper clings to surface
- Add more paper and wet in similar manner
- Allow poultice to dry completely before removing
- Repeat as necessary

Graffiti Remediation

Graffiti Remediation

Takes one of two forms:

- **Removal** – involves the removal of graffiti from the substrate
- **Reintegration** – refers to the masking of graffiti to make it less conspicuous to visitors

Graffiti Removal

Takes one of two forms

- Mechanical – includes brushes, erasers, abrasive equipment, picking tools, etc.
- Chemical – use of paint strippers or solvents

Graffiti Removal Considerations

- Method should first be tested and monitored on areas not containing rock art
- Least intrusive method should be implemented first and gradually worked towards more intrusive
- Dry methods are preferable to wet (e.g. water and solvents)
- Soft tools are preferable to hard/firm tools

Graffiti Removal Considerations

- Non-toxic chemicals are preferable to toxic chemicals
- Treatment should be restricted to small areas and only areas needing treatment
- Debris left on the ground should be disposed of appropriately

Graffiti Removal Considerations

- New graffiti should be photographed and documented
- Graffiti is more easily removed when fresh
- Graffiti should be removed as soon as possible as sunlight and heat can lead to cross- polymer linking and to discourage more occurrences
- Prior to removal stake-holders should be consulted to determine what is significant or not (e.g. historic graffiti)
- Pre and post removal documentation of treated area

Chemical Methods Considerations

- Ensure that chemical make-up of compound will not adversely affect support
- The effects of chemical compounds may take days, months, or years to manifest
- Rock surfaces are porous and will absorb any liquid applied to them
- When a chemical is applied it should be removed as thoroughly as possible

Chemical Methods Considerations

- Chemicals not completely removed will continue to react to support post treatment
- May include breakdown of rock support, staining it, or chemical alterations
- Chemicals that have dried within rock may be reactivated by rainwater or increased humidity
- Consider how chemicals may affect analytical techniques (e.g. dating methods, pXRF, DNA testing, etc.)

Reintegration Considerations

- Non-permanent paints (e.g. water soluble acrylic paints) that can be easily removed should be used
- Should only be applied to areas containing graffiti and never to graffiti overlaying rock art
- Paint with a modern chemical signature should be used to distinguish it from prehistoric paint
- Incised graffiti can be infilled using water colors or dry mineral pigments

Reintegration



Paint Stripper

- Lambert (2007) recommends 2 paint strippers: Berger Strip and Poly Stripper
- Contain methylene chloride and xylene with gelling agent
- Chemical should be applied with brush and allowed to sit 10 minutes
- Area should then be washed with non-ionic detergent (e.g. Lissapol N)
- Area should then be cleaned with water



Elephant Snot

- Apply to rock art panels sparingly
- Apply only to affected surface
- Let stand for 24 hours
- Must be washed off using pressure washer
- Capture washed material in absorbent pads



Portable Air Abrasive Unit

- Use fine spray consisting of dolomite and glass beads
- Unit etches surface leaving underlying paint intact
- Should be used in a controlled way



Laser Ablation



Using Water

- Can be done on charcoal or chalk
- Should only be done if there is enough mineralization to prevent removing or bleeding paint
- Paint that has a soft powdery appearance should not be washed
- Test on small area first
- Should be done **sparingly**



Using Water

- Lambert (2007) recommends water with 1:2000 parts non-ionic detergent
- Use low pressure water
- lightly mist with deionized water
- Water and chalk run-off should be captured in paper towel or cotton cloth to prevent bleeding



Risky Methods

- **Sand blasting** – leaves clean smooth surface brighter than support
- **Pressure washers** – uncontrolled and abrasive
- **Wire brushes** – can be intrusive on rock and leave metal filings
- **Caustic Substances** – acid, oven cleaner, cleaning supplies
- **Tools** – chisels, grinders, sanders



Mitigating Effects of Visitor Impacts

Remove Refuse

- Remove modern refuse (i.e. non-historic artifacts)
- Discourages others from leaving refuse
- Studies have shown that keeping sites clean of refuse result in fewer occurrences of vandalism

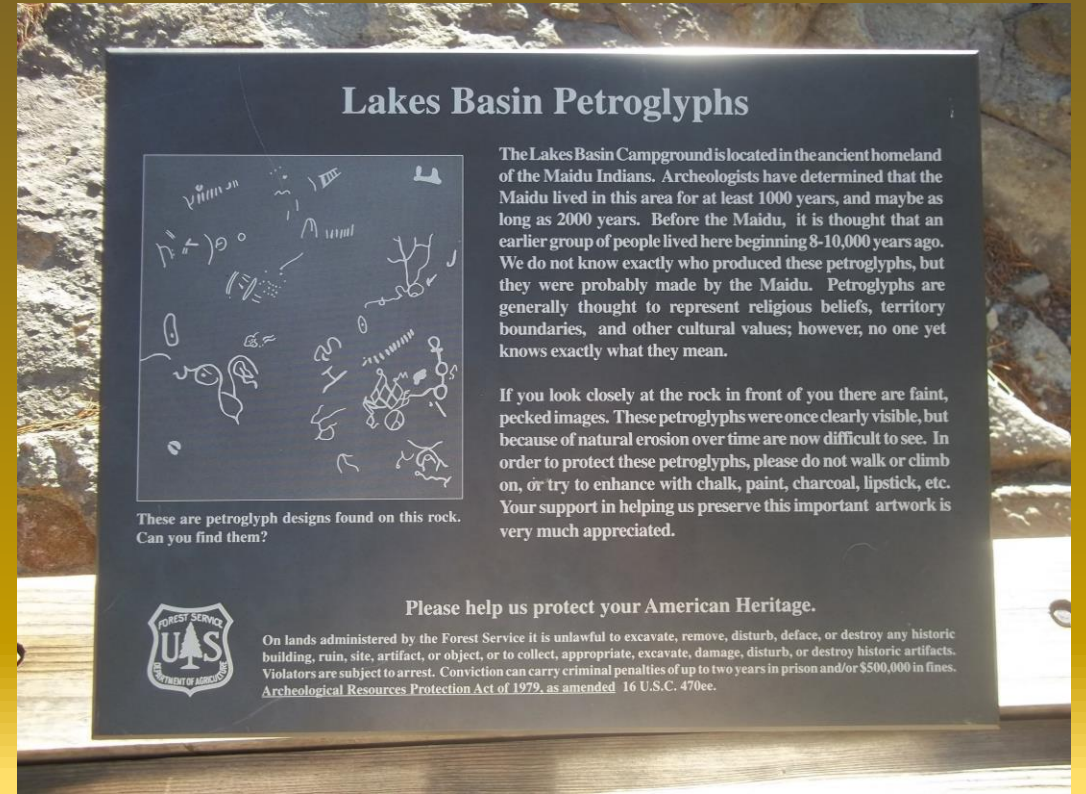


Education and Outreach

- Implement Education and Outreach programs
- Use every opportunity to imbue a conservation ethic
- Reaching one person on a tour can have a ripple effect as visitors pass a conservation ethic onto others
- It is **our** responsibility to education the public



Signage



Guided Tours

- Educate tour staff to monitor visitor behavior/misbehavior
- Effective staff to visitor ratio
- Define ingress and egress for visitors
- Protect path used by visitors
- Restrict number of visitors if staff limited



Self-guided tours

- Restrict visitor access to site
- Define path of ingress/egress
- Provide acceptable view of rock art (e.g. photographic view)
- Infrastructure development (e.g. platform, boardwalk, pavement, mulch, matting, etc.) can be fairly affective
- Pamphlets or signage effective
- Sign-in books



Physical Barriers

- Can be fully restrictive (e.g. fence, cage, etc.) or psychological barrier (e.g. museum-style barrier)
- Should provide adequate view of panel
- Should not disturb subsurface deposits
- Consideration should be given to not alter microclimate (e.g. vegetation, light levels, air circulation, dust accretion, etc.)



Rock Support Stabilization

Artificial Calcification

- Mimics natural calcification process
- Net infused with calcium rich spheres draped over panel
- Rain water dissolves spheres and deposits in cavities
- Slightly acidic water can be added to accelerate process
- Larger cavities can be infilled with calcareous rock
- Process can be reversed by dissolving calcium carbonate deposits with acidic water

Final Thoughts

- When developing a conservation management plan **be informed**
- Collect sufficient data prior to preparing and implementing a conservation management plan
- Establish way of evaluating effectiveness of management plan
- Be willing to change the plan if parts of all of it are ineffective
- Management plans should be malleable to changing conditions

Final Thoughts

- Adequate data can take months or years to collect
- Don't plan **interventions** until adequate data is available
- Data collected by you can be used by **future** site managers
- We have a collective **responsibility** to properly manage sites
- Once a site is gone, it's gone **forever**

Shameless Plug



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Questions???